SCIENTIFIC AMERICAN

Painted by Edwin F. Bayha

The Business Side of "Safety First"
Accident Prevention in Steel Making

Vol. CX. No. 6
February 7, 1914

Munn & Co., Inc., Publishers
New York, N. Y.

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"There's the Car for Economy"

NO one knows this better than the expert mechanic at your garage. He's been expecting this sweeping change in automobile construction. He knew that the demand for economy has been growing and growing until the public could wait no longer.

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Munn & Co., Inc.
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361 Broadway
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CONTENTS:

	PAGE
Electrically Lighted and Started Motorcycle	111
Graphical Studies of Marriages of the Deaf	111
A New Building Material	111
Is Our Target Practice Equal to the Best?	112
The "Safety First" Movement	112
The Need of an American Aeronautic Motor Competition	112
Science, Aeronautics and Automobile Notes	113
The SCIENTIFIC AMERICAN "Safety First" Medal	114
The Business Side of the "Safety First" Principle	115
A Wireless Danger Aboard Ship	116
Oil and Wool from Pine Needles	116
Correspondence	117
Earthquakes and the Panama Canal	117
Safe and Unsafe Practices in Railroading	118
How Some Very Common Accidents Are Caused	119
Four-gun Turrets of the French Battleship "Normandie"	120
Fighting Grasshoppers in Uruguay	120
Safety in Steel Works	121
Curiosities of Science	123
The Human Body in Action	124
Military Aeronautics in the United States	124
Spontaneous Combustion	125
Safety in an Automobile Factory	126
The Strangest Form of Cloud: *Mammato-cumulus*	127
A Portable Field Searchlight	127
The Expanding Weather Map	127
Proposed Improvement of the Patent Office	130
The Eruption of Sakurajima	130
Dried Fruits and Their Use	131
Variations in Atmospheric Ozone	131
A New Fish Curing Method	134
Antarctic Postage Stamps	134

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THOUGHTFUL people throughout the country arrange policies in the POSTAL LIFE INSURANCE COMPANY because, *first*, it supplies sound legal-reserve protection at low net cost and, *second*, because it performs an important service in *health-conservation* for its policyholders.

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The Only Non-Granular or Fibrous Bearing Bronze

Wears Twice as Long as Any Other Bronze Made

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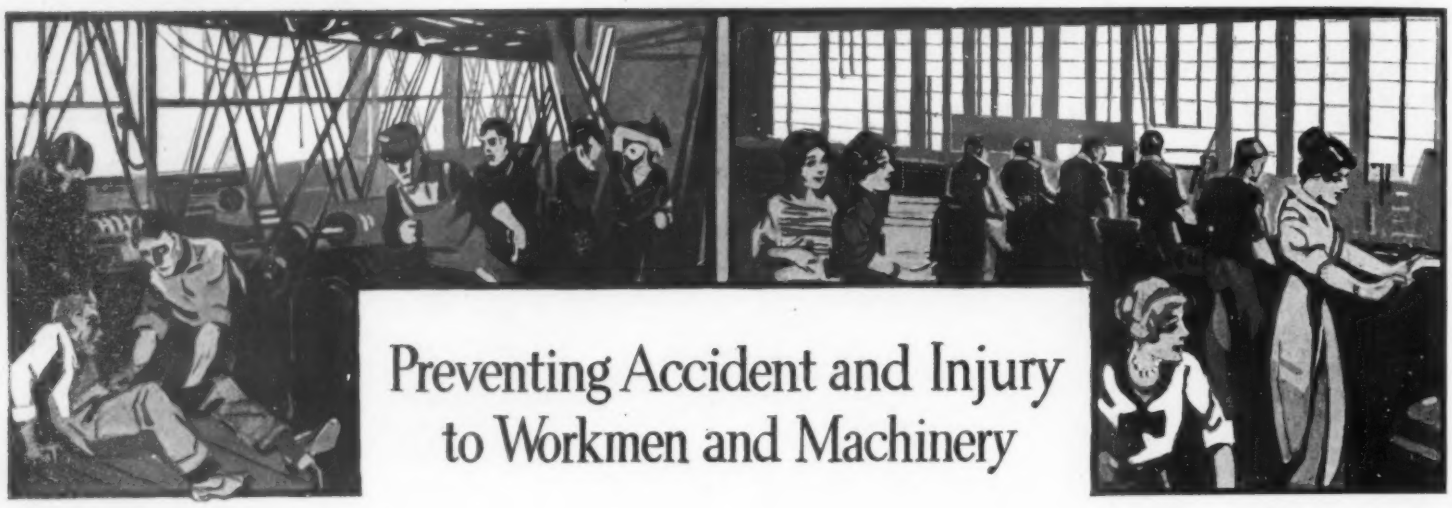

Preventing Accident and Injury to Workmen and Machinery

"AN ACCIDENT!" The news flashes through the plant. There is a scurrying of many feet, then a lull.

"Anybody hurt?" is likely to be the first inquiry. Maybe the answer is, "Bretley broke his arm." Or may be the answer is, "Just a scratch, but the big cutting machine is a wreck."

It is a familiar story repeated with thousands upon thousands of variations month after month. The Manufacturers' Association says that 500,000 *avoidable* accidents occur within a year.

"Avoidable." Men are turning to that word—they have begun to consider safety with more care than ever before. New York established a Museum of Safety. A Congress of Safety has gone deep into this vital problem of applied conservation.

Safety is being made a science—"Safety First," a watchword.

And the science of safety finds its chief safeguard in *mechanical security*. To attain mechanical security in all the many avenues of its application no step is more direct than that made possible by Electricity.

For example, electric motors placed within the base or frame of a machine so as to drive the machine with gears or belts that are totally enclosed, make it practically impossible for man or woman to have clothing caught and life endangered.

Power application in this form cuts out all the many dangers of overhead shafting—the danger of falling sections, belt wheels, broken belts, which have filled the history of American manufacturers with so many tragic chapters.

Beyond this, it directly decreases fire danger by eliminating bearings that may be overheated to the point where they cause fire, as well as other frictions that are a constant fire danger.

The method of control is another "safety first" feature of the electrically operated shop. Motors are started and stopped by push buttons, located at the most convenient point on each machine. Whenever an overload or other unnatural condition of operation occurs, the motor stops automatically—*before* the condition becomes dangerous. This method of controlling power eliminates to a large extent the "personal element" as a factor in safety.

To decrease fire danger is to reduce insurance rates. In a still larger sense the increased safety of electrical power and motor drive are themselves an insurance that means unquestionable economy. It was declared at a session of the Manufacturers' Association that "a conservative estimate of the economic loss in this country, through industrial accidents, places it at a quarter of a billion dollars each year." The actual experience of manufacturers who have installed the modern system of using power made possible by electricity, proves that an immense reduction in the number and seriousness of accidents and injuries, and a vast saving of money penalties, may be confidently counted on to follow the extension of this system.

Add to this insurance the productive advantages of the motor drive method, in small plants as well as in large plants, the low cost of installation and of maintenance, the labor economies, the advertising effect of a clean, lighter, more attractive-looking plant, and the business wisdom of this method needs no further argument. Take up the matter today with your electric power and light company or any General Electric Company dealer or agent in your vicinity. You will find them more than glad to cooperate with you, and no matter how complex your problem may be, they have at their command the service of any part of our organization that may be most helpful to them and to you.

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SEVENTIETH YEAR

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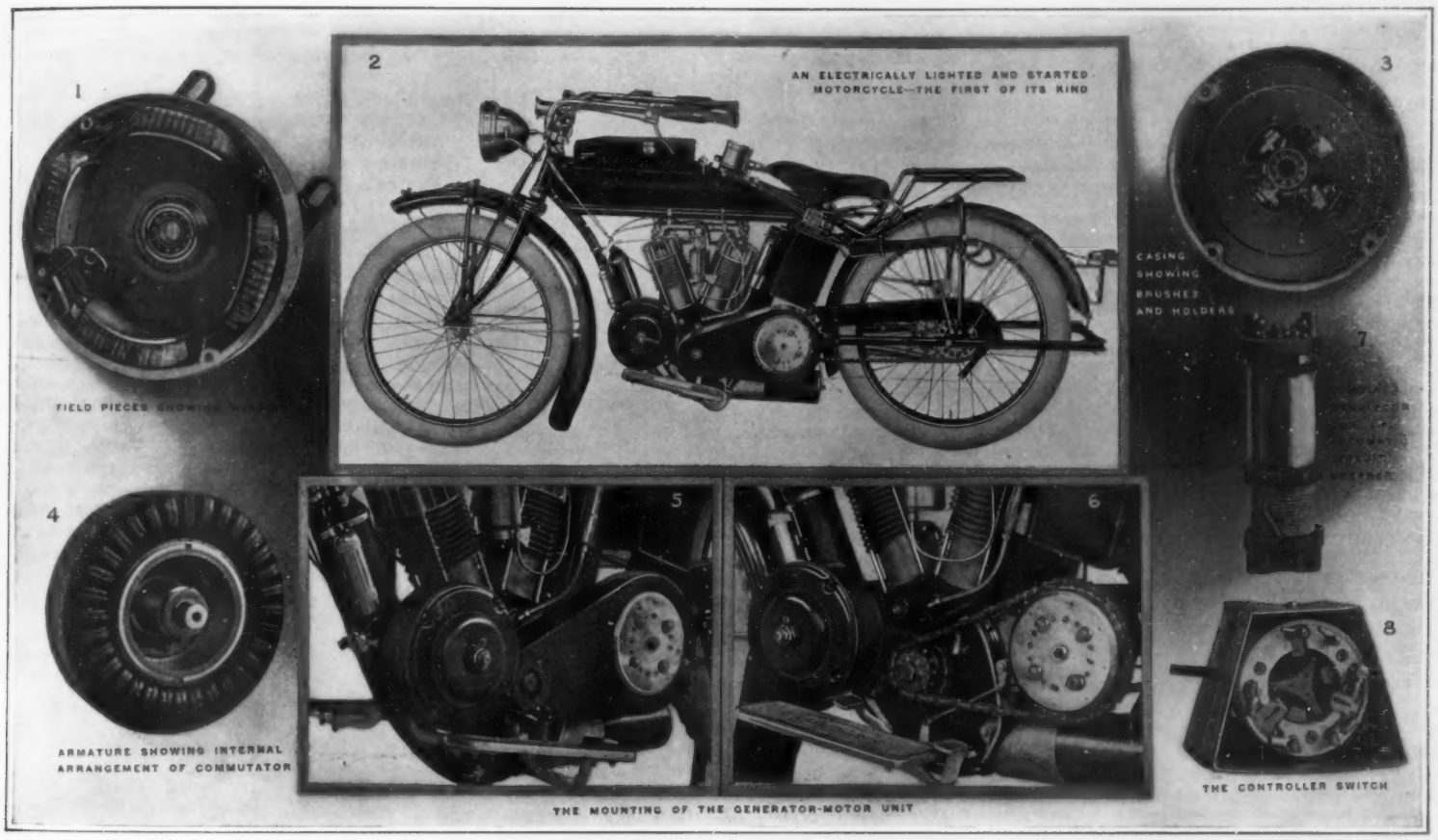

Electric lighting and starting equipment for motorcycles.

Electrically Lighted and Started Motorcycle

WHEN, about a year ago, one prominent manufacturer of motorcycles placed on the market a machine equipped with an engine starter of the spring type, thus marking a new era in motor bicycle construction, it looked as though the last word had been said. Now, however, there has been placed on the market by another maker a motorcycle which not only has a complete electric lighting system even to the dynamo, but which has an electric engine starter as well. This year in the motorcycle field, electric lighting is common, though so far only one maker has attempted to follow in the footsteps of the automobile engineer to the extent of equipping with an engine starter, too. His machine is shown by the accompanying illustrations.

Compactness in the electrical equipment is absolutely necessary, of course, and this has brought about the development of a clever combined generator and starting motor that has a number of individual and highly interesting features. The combined unit is mounted just ahead of the engine, to which it is attached by means of bolts and straps. It drives and is driven through a roller chain which gives a reduction of approximately 2 to 1. The battery has six cells and is split into two units, half being on either side of the frame at the back of the seat post. For operating the head lamp and the tail lamp the voltage is six, but when used for starting purposes the cells are connected in series, giving 12 volts. To start the engine it is merely necessary to close a small switch on the handle bar. Immediately after the engine has picked up its own cycle of operations the switch is thrown the other way, making the necessary connections to charge the battery at six volts. The change in the mechanical unit from starting motor to generator is made automatically as the armature speed is increased. The machine is compound wound and with the batteries in a fully charged condition delivers about 420 watts at 35 amperes for starting, the motor being sufficiently powerful to "crank" the gasoline engine at nearly 500 revolutions a minute. The time necessary to start the gasoline engine varies from about four seconds in warm weather to about 12 seconds in cold weather, provided the engine is in good condition.

The construction of the generator-motor unit is novel. The commutator is within the armature coils instead of being at the end of the armature shaft as is usual; thus great compactness is obtained. The four pole shoes are carried on the field piece casting and the brushes are mounted in holders on the case cover.

Obviously, some device to maintain the output of the generator practically constant regardless of vehicle speed is essential and this is contained in a casing mounted just above the generator-motor unit. This device performs a dual service, for in addition to preventing the charging current from mounting too high at high engine speeds it breaks the connection automatically between the generator and the battery when the voltage of the former becomes less than that of the latter, as when the engine is stopped, for instance.

The battery, as already has been made plain, is contained in two cases carried at the back of the seat post. The casings are substantial and the vents are so arranged that the electrolyte cannot be spilled in the event of the machine's being turned on its side. The generator-motor unit is quite small, measuring but 10 inches in diameter and 3½ inches in width.

Graphical Studies of Marriages of the Deaf

THE Volta Bureau possesses a card catalogue relating to 4,471 marriages of deaf-mutes, reported in Dr. E. A. Fay's work entitled "Marriages of the Deaf in America," published by the Volta Bureau. Each card is illustrated by a graphical diagram prepared by Dr. Alexander Graham Bell, exhibiting at a glance the number of brothers and sisters and children of the partners in marriage, and whether they were deaf or not. An analysis of these 4,471 marriages appeared in *The Volta Review*. No information concerning offspring was obtained in regard to 974 of the marriages; and in 419 cases the marriages took place within a year of the date of report, so that offspring had not then appeared. Eliminating the above, the table deals with 3,078 marriages of a year's standing or longer; 434, or 14.1 per cent, were childless, so that the children recorded were the product of 2,644 marriages. Omitting two of these on account of incomplete returns, the table shows that 2,342 of the fertile marriages resulted in hearing offspring alone, and that in 300 cases deaf offspring were also produced.

Dr. Bell has now presented to the Volta Bureau a graphical study of the 300 marriages which resulted in deaf offspring, showing the ancestry of the husbands and wives, the number of children produced, and how many were deaf and how many could hear. The brothers and sisters of the ancestors are also given, showing how many were deaf and how many could hear; and each chart collates the information scattered through Dr. Fay's book relating to deaf relatives in collateral lines of descent. The marriages are designated by the same numbers used by Dr. Fay in his published work. Additional details, preserved in the confidential archives of the Volta Bureau, are accessible to *bona fide* investigators upon request.

A New Building Material

THE French inventors of a new system of metallic wall covering claim quite a superiority over plaster or wood, and cheapness as well. On the laths are mounted light stamped sheet steel plates of handsome decorative design, made in a variety of standard sizes from 2 feet square up to 6 feet by 2 feet and the like. Ornamental cornices are also used, so that there is no difficulty in giving a metallic covering to ceiling and walls, and the effect is most handsome. The advantages of metal are numerous, for humidity does not penetrate, and good hygiene is secured from absence of microbes and insects. The thickness is not over 0.0012 inch and the weight 4 pounds per square yard. Matched joining of plates gives a uniform surface whose joints the eye cannot detect. Such joints are treated in place so as to be quite tight.

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The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

The purpose of this journal is to record accurately, simply, and interestingly, the world's progress in scientific knowledge and industrial achievement.

Is Our Target Practice Equal to the Best?

THE SCIENTIFIC AMERICAN recently stated that our target practice was probably no better than that of the other leading naval powers, and not nearly so good as that of one particular navy. We have frequently been asked which particular navy it is that is doing better work at target practice than our own. There is no reason for concealing the fact that it is the British navy which is so greatly in the lead, and that the cause of its superiority, as compared with our own, is its adoption of what is known as the "director system" of firing. Director firing was developed by Admiral Sir Percy Scott, and it was he also who elaborated the system of fire control by spotting, which he gave to an American officer, a close friend of his, when they were on the China station years ago —a system which has been steadily followed and equally improved in both navies for years; which is still in force in our navy; and which was abandoned last year in the British navy in favor of the vastly superior "director system" as devised by Scott.

In the old Scott system, which we are still following, there is a pointer at each gun, who tries to keep his sights continually on the target. When all the guns are loaded the fire-control officer sounds a "buzzer" at each gun, and on hearing this each pointer is expected to instantly fire his gun—*if he is exactly on the target.* If he is above or below the target he must not fire, but must wait for the next round. Now it is human nature to want to be "in the game," and too often the pointer will "let fly," whether he is on or off the mark. If his horizontal wire is above the target by ever so little his shell may drop a thousand yards over the target, if below he may be as much short. The result is that the spotter is bewildered by the wide range of "dispersion" as it is called and does not know whether the range for the whole battery should be put "up" or "down" or left where it is.

Now in the director system the errors due to the human element are eliminated by using one telescope and one pointer for the whole battery. Only one gun —the master or director gun—has a telescope and at this is placed the crack pointer of the whole ship's company. The other guns are trued up in parallel with the master gun and move exactly with it. The master gunner keeps steadily "on" the target, and the instant the battery is loaded he presses the firing button, and the guns being elevated to exactly the same degree, the shots fall bunched in practically the same place, and the spotter on the top of the mast is able to tell with great accuracy how far the splash is "short" or "over."

It is this cutting out of the errors of the individual pointers and consequent bunching of the shots that makes director firing such a great step in advance of the old Scott system, which we are still using. The spotter can quickly pull the salvos onto the target and hold them there unerringly.

Now for results. After spending no small amount of his own money in the purchase of gear with which to test his system on his own ship, Admiral Scott succeeded in getting it applied to a dreadnought, the "Thunderer." This ship was sent out with a sister ship, the "Orion," fitted for individual pointing, as practised by us to-day, and, under exactly identical conditions of wind, weather, range, and speed, she put four times as many shots through the target—at least so said the cabled dispatches at the time. So startling was the improvement that the British government voted the full sum necessary at once to apply the system to the whole fleet.

But there is nothing like first-hand information; and we have it from Sir Percy Scott himself, who during a lengthy conversation last year on director firing in general, informed the Editor that the *introduction of director firing had increased the hits in target practice for the whole navy over one hundred per cent.*

What then are we to make of the statement of Rear Admiral Joseph Strauss, U. S. N., Chief of the Bureau of Ordnance, before the House Naval Affairs Committee, on January 19th, that the Scott director system "had been experimented with in the American Navy and found not as accurate or satisfactory as the American method of firing salvos"? The American method is the old Scott method, and we have the best grounds in the world for stating that the director experiments referred to were not the true Scott methods, but only a guess at them, and a very wide guess at that.

This depreciation of director firing by Mr. Strauss is most unfortunate, made as it was to the House Naval Committee, on whom the further policy of advancement so greatly depends. For the information of the House we repeat that the Scott system has never yet been tried out in our navy; the SCIENTIFIC AMERICAN learned last year by personal investigation that director firing is absorbing the closest attention of navy artillerists throughout Europe; that because of the lack of initiative in this matter in our Bureau of Ordnance we are already far behind one great naval power in target results; and that in view of the active work being done in director firing by Germany (to mention one other power), the results of which, the writer is reliably informed, are very promising, we are in danger in falling behind that country in target practice as far as we have in battleship strength.

The "Safety First" Movement

WHATEVER may have been the sins of the great American trusts, a blind and cruel disregard of the physical welfare of their employees was not one of them. To be sure, there have been instances of long hours and arduous labor; but the men who had imagination enough to create corporations capitalized at half a billion dollars and more had also imagination enough to see the business folly of endangering life or of working a man to the point of exhaustion. Taken as a whole, accident prevention and welfare work have been more developed by our great industrial companies than by smaller manufacturers. Indeed, were it not for the salutary laws that have been passed in most States to check the frightful loss of life and limb that has hitherto marked the course of our industrial expansion, it is probable that those merciful provisions which stand not only for humanity, but also for good business, would still be confined to the trusts.

The history of the safety first movement in America is in that respect a duplicate of the history of the movement abroad. Long before the social democrats insisted upon the passing of those stringent accident prevention laws, for which Germany is famous the world over, the larger German manufacturing companies had instituted accident prevention and welfare systems that testified to their humanitarian instincts and their good business sense. Systematic accident prevention is at least fifty years old in Germany; in the United States hardly fifteen years old. While we can hardly boast that we have approached the high standard set by Germany, still the record which we have to show for our fifteen years is creditable indeed.

But much more remains to be done—how much can be gleaned by examining statistics. From a chart which was exhibited by the Prudential Insurance Company of America at the recent International Exposition of Safety and Sanitation, it would follow that there are 25,000 fatal industrial accidents per annum in the United States, and some 300,000 injuries. The mere possibility of being able to state in statistics the approximate number of our industrial casualties is a step in advance; for as late as 1908 it was impossible to estimate with any accuracy at all what was the toll we paid in crushed limbs and snuffed-out lives. Now at least we know how vast is the problem to be solved, how much needless suffering we inflict and how much we lose in dollars and cents, because we have hitherto failed to realize the necessity of guarding men as well as machines.

It has been estimated that it costs about $300 to train a skilled workman to perform a new task, and that ultimately he represents an investment of about $2,000 to his employer. Considering the subject of accident prevention from this cold-blooded standpoint, our business policy has not been all too wise.

Now that there is an awakening of employers to the duty which they must exercise, now that employers' liability statutes have done away with the antiquated common law conception of negligence, we may watch for a very marked improvement in deaths and injuries.

As an example of the splendid work which the large corporations are doing in the education of their employees we may instance the Pennsylvania and New York Central Railways and the United States Steel Corporation. Elsewhere in this issue will be found pictures which tellingly set forth what the railroads are doing to make one of the most hazardous of occupations reasonably safe, and how the greatest steel manufacturing company in the world protects the thousands intrusted to its care. The work of the steel company is particularly difficult because it is dealing with employees who come from half a dozen different countries and who speak not one word of English. Railroad companies have their problems, too, because they are dealing with the most ponderous and at the same time the most swiftly moving machinery that we know.

It would be hard to estimate with any degree of accuracy how much money is annually spent in driving home the safety first principle; but it must run well up near a million dollars, if we take into consideration what the larger companies spend in issuing educational pamphlets, in employing lecturers, in installing safety guards in machine shops, and in maintaining splendidly equipped emergency hospitals. That it pays to do this is evident from the figures published by the Pennsylvania Railroad. Surely, the reduction of serious accidents to the shop employees of that company alone from five to seventy per cent is magnificent.

America's Need for an Aeronautical Motor Competition

IF we may credit the reports of progress in aeroplane design, the most serious requirement of aviation to-day is a suitable engine. Inherent stability has been provided in Dunne's invention; automatic stability in Wright's invention; nearly the limit of efficiency has been attained in propeller, wing and body design. When well above the earth, a skilled pilot, in whatever attitude, normal, oblique, or reverse, now feels sufficiently safe. Give the circus aviator a strong, reliable motor; he will perform anywhere, however forbidding the terrain beneath. To strength and reliability add economy, and the commercial aviator will make the aeroplane pay dividends by performing useful service to the community. What aviation most needs, then, is a strong, reliable, economical engine.

America has many motor firms, but too little exchange of ideas. An engine tournament, a public show of merits is needed. A competitive test of all the best aeronautical motors, followed by a published report, would be most serviceable to builders and users alike. An adequate testing plant, established by the United States Signal Corps, is now available at the Bureau of Standards, in Washington. All, therefore, that is required to launch a first-class competition is a monetary prize, or the guarantee of orders on a showing of merit, sufficient to attract the engine builders.

The SCIENTIFIC AMERICAN would recommend that a fund be established for a motor competition similar to that recently held in Berlin. The German Emperor offered, from his private purse, a prize of 50,000 marks for the best German aero motor. This sum was, by contributions from the country at large, soon swelled to 125,000 marks, and resulted in a competitive test of two or three score of the best aeronautical engines. Who will emulate the German Kaiser in America?

In our issue of August 31st, 1912, we commended the movement to establish a national aerotechnical institute. Such an establishment, under direction of the Smithsonian Institution, is now practically realized. It has the co-operation of four departments of the Government, including the Army and Navy, and of various private laboratories and air craft companies. It, therefore, needs only the approbation of Congress to make it truly national. The Aeronautical Advisory Committee of the Smithsonian Institution is especially qualified to receive and properly administer a prize for an aeronautical motor competition, more particularly since its membership comprises delegates from both the Signal Corps and the Bureau of Standards. We would recommend that the proposed prize and competition be placed in charge of this committee.

The Haze of 1912.—The remarkable turbidity of the atmosphere in the summer and autumn of 1912, with its attendant optical phenomena, has generally been attributed, as previously noted in these columns, to the presence of dust from the eruption of Mount Katmai, Alaska. However, the question as to the cause of this haze has recently been reopened by Dr. Barkow, who, as a member of Filchner's Antarctic expedition, observed similar phenomena in latitude 70 deg. south, as early as the middle of June, 1912, and during some months thereafter. Cirrus clouds of unusual altitude were noted, and the illumination of the northern sky at midday (with the sun below the horizon) was so bright that reading was possible for several hours. In other words, the phenomena strongly indicated the presence of some light-reflecting substance at an abnormal height in the atmosphere. As it is not thought possible that dust from Katmai could have traveled to the Antarctic so soon after the eruption, Dr. Barkow suggests that the dust was of cosmical origin, though its effects were probably heightened in the northern hemisphere by volcanic dust.

Science

Radium in Central Asia.—Large deposits of radium ore have been discovered in the Ferghana district of Russian Turkestan.

Dr. E. A. Fath, director of Smith Observatory, Beloit College, has resigned his position as director of that Observatory in order to take up work as president of Redfield College, Redfield, S. D. He assumes his new office on March 1.

Captain Scott's Journals, kept by him during his antarctic expedition, have been deposited by Lady Scott in the British Museum, where they have been on view since January 17th, the second anniversary of Scott's arrival at the south pole. They comprise the three small, pencil-written books that were found on the explorer's body by the searching party in November, 1912.

A Swedish Antarctic Expedition, now in process of organization, is to sail in the autumn of 1915 and spend five years in exploring in the neighborhood of Graham Land, the coast of which was explored by a previous Swedish expedition, under Nordenskjöld, in 1902-03. The scientific staff will comprise ten men experienced in polar research. Arrangements are being made to have the expedition provisioned every season by whaling vessels, which have recently become very numerous in that quarter of the globe. The outfit is to include wireless telegraphy.

Steam Otter Trawlers had a phenomenally successful season on the Newfoundland Banks during the past year. This method of fishing has now assumed such importance as to cause anxiety concerning the conservation of the world-renowned Newfoundland fisheries. While the new methods involve less danger and hardship to the fishermen than the old, and are more certain and profitable, it is claimed in some quarters that by destroying spawn and small fish of no commercial value and uprooting the marine vegetation of the bottom, trawling will result in the rapid extermination of the fish and the ruin of the fisheries. In order to discourage this practice, the Canadian Parliament has passed a bill (the Hazen bill) to prevent French otter trawlers from coaling at Canadian ports.

The Newfoundland Reindeer Herds, established five years ago by Dr. Grenfell, have proved as great a success in Newfoundland and Labrador as have the herds of the United States Bureau of Education in Alaska, where the pioneer experiments were made. The original herd of 300 Lapland reindeer has now increased to over 1,200. In northern Newfoundland and in Labrador there are few horses or dogs for haulage purposes, while the Labrador dogs are vicious brutes which attack and devour even human beings. Harnessed to a sled, two reindeer will pull 500 to 700 pounds 30 miles a day, and they are also successful as pack-animals, carrying loads up to 200 pounds. The other economic uses of the reindeer are well known. After another season it is proposed to distribute the animals to the mission stations in Labrador, where eventually the Alaskan practice of lending small herds to the natives will probably be adopted.

The Condensation of Moisture in the Atmosphere—i. e., the initial step in the formation of clouds, fog, rain, hail and snow—has been explained for more than a generation by the presence in the air of myriads of minute (mostly ultra-microscopic) "dust" particles, each of which was supposed to serve as a center of condensation. The well-known instrument invented by Aitken, in 1888, in which, after a small measured volume of air has been cooled by expansion, the resulting droplets of water are inspected through a microscope and counted, is known as the "dust-counter," because it has been assumed that the number of drops formed in this process represents the number of particles of "dust" in the given volume of air. This idea is intrenched in the very latest works on meteorology in the English language, though qualified by the admission that in a highly supersaturated atmosphere, such as may be produced at will in laboratory but hardly occurs in nature, condensation also occurs on ions, in the absence of "dust." However, if we turn to recent German meteorological literature (e. g., Wegener's "Thermodynamik der Atmosphäre" or the third edition of Hann's "Lehrbuch der Meteorologie," now appearing in parts) we find that a new idea, after slowly taking shape in the scientific journals for several years, has now definitely crystallized into the belief that "dust," in any ordinary sense of the term, has comparatively little to do with condensation in the atmosphere. Yet it is still believed that the water-droplet forms around a something-or-other that is not water. Ignorance as to what this something is finds expression in its non-committal name of "nucleus" (German Kern). Perhaps it may be a molecule of a hygroscopic gas. Several such gases occur in small and variable amounts in the atmosphere. The whole subject is still in a highly problematic stage, the only definite fact being that "dust" has been shorn of its time-honored function as a cloud-maker, and that Aitken's Staubzähler has become a Kernzähler.

Aeronautics

A New Military Aeroplane.—On January 16th last, the aviator Espanel tried out at Villacoublay a new armored military biplane, constructed in accordance with plans furnished by the French Ministry of War. The apparatus is intended to repel dirigibles. It is armed with a rapid-fire machine gun.

Charles K. Hamilton.—An amazing career was that of Charles K. Hamilton, the aviator, who recently died in New York city. He was in the air before there were flying machines, for he it was who with cat-like agility saved himself from injury in more than one fall in experimenting with Israel Ludlow's gigantic kites. When the aeroplane appeared, Hamilton was in his element. His swoops and his dips thrilled thousands of spectators when flying was still a novelty. Perhaps his most notable exploit was his flight from New York to Philadelphia and return on June 13th, 1910—one of the most important cross country flights of its day.

Aerial Stowaways.—The enormous biplane built by Sikorsky was referred to in this column some weeks ago. A correspondent of the London *Telegraph* who resides near the military aviation ground at St. Petersburg, where the machine was berthed—no shed was large enough to contain it, so it had perforce to be kept in the open—and had frequent opportunities of observing the huge machine, both in the air and on the ground, supplies his paper with the interesting information that when the great biplane was well up in the air on one of its first trial trips, two workmen were discovered in the cabin who had stowed themselves away for the purpose of stealing a trip in it.

The Wright Stabilizer.—At a recent demonstration of the Wright stabilizer before the committee which awarded the Collier trophy to the invention, something more was revealed of the side control. It seems that in the actual device a gradual effect is assured, because a windmill takes the place of the servomotor which we described in our recent article on the stabilizer, and because a clutch is substituted for the three-way valve. An auxiliary propeller is rotated by the relative wind and thus furnishes an amount of power for working the side control, strictly in proportion to the disturbing force. A clutch, moreover, is obviously capable of a graded effect. Vanes might be provided to make the windmill face side gusts squarely. The idea of deriving proportionate power from the air itself in combination with pendulum control is certainly most ingenious.

Navy Flying Machine.—That aeroplanes should eventually be placed aboard all battleships was one opinion out of a number of important conclusions recently arrived at by a board of officers appointed for the purpose of drawing up a comprehensive plan for the organization of a naval aeronautic service. The board ordered by the Secretary of the Navy was composed of the following officers of the Navy: Captain W. I. Chambers, senior member, and Commanders O. B. Britain and S. S. Robison, Lieutenants M. H. Simons and John H. Towers, Naval Constructor H. C. Richardson and First Lieutenant A. A. Cunningham of the Marine Corps. The board emphasized the opinion that aeroplanes should eventually be placed on board all battleships. Also, that any group of ships on scouting duty or detached service, will require their services. The bulk of the stores, supplies and implements for these aeroplanes should be carried by the fleet auxiliaries so as not to encumber the fighting units. Special ships for aeroplanes and air craft generally should be considered, though not immediately recommended.

Prizes for 1914.—The most important prize to be won in 1914 is that of $25,000 which is open to British-built aeroplanes and engines over a 1,540-mile circuit of the British Islands, with an additional prize to the engine constructor. Then there will be a first prize of $25,000 for the best performance in a reliability trial, of a British-built engine, with an additional $200,000 in orders. Other big prizes which may be won in 1914 are $50,000 for the first aviator to fly from Europe to America; $100,000, with several minor rewards, for an aeroplane offering the greatest degree of safety, this competition being started by the Union Aerienne de France, and open to constructors of all nationalities; $2,000, offered by the Paris Municipal Council, for a race from capital to capital, probably to some place in the Near East, via Vienna and Budapest; $5,000 for a hydro-aeroplane race of 150 nautical miles, open to all nationalities, organized in connection with the Coupe Jacques Schnieder; $4,000 for an all-around France competition with sixteen stopping places; $4,000 for the circuit of Paris competition, the distance being about 125 miles; $2,500, offered by a newspaper, for a flight across Africa from Cairo to the Cape, the distance being about 5,600 miles; a prize to be given to the first pilot reaching Johannesburg; $2,000, offered by the Aero Club de France, for the longest direct non-stop flight; $1,800 Michelin prize for the greatest number of hits on a given target in competition for bomb throwing from aeroplanes.

Automobile

Lubrication of Worm Drives.—Advocating the use of either castor, sperm or lard oil for the lubrication of worm drives, Mr. Lanchester, inventor of the type of worm and wheel that bears his name, suggests that one is about as good as the other provided it is pure and free from acid. He suggests, too, that a mixture of any two of them may be better than one alone, for when they are mixed better control of viscosity is obtained. Thus, for instance, lard oil which has a tendency to solidify at temperatures lower than normal can be made more suitable and this objection removed by the judicious addition of sperm or castor oil.

Spring Suspension of Cycle-cars.—Because of their light weight and narrow tread, the spring suspension of cycle-cars manifestly is a matter of the gravest importance. In this connection, it is interesting to note that of late several engineers prominent in the automobile industry have offered as their opinion that the cantilever type of spring seems best adapted for these light little vehicles. This type of spring possesses two cardinal advantages: It is less expensive to manufacture than many other types and in action eliminates practically all of the uncomfortable and often dangerous rebound that is a feature of nearly all other springs.

Danger in Over-powering Light Cars.—With the marked stimulus that has been given the building of light cars during the past few months there becomes apparent a danger that would seem to have been overlooked by a majority of manufacturers. It is, briefly, that it is quite possible to over-power these little vehicles. As light vehicles they scarcely are calculated to withstand the abuse that must follow as the result of the possibility of high speed, which always exists as an invitation to the owner to exceed the moderate rate of speed conducive to longevity. With the powers that are being used in those cars that have put in an appearance, it is to be feared that odium will fall on the class almost before it has become established. Perhaps some sort of an engine-governing device would solve the problem.

Noteworthy Performance of Knight Type Engine.—As a matter of record, the performance of a Knight type sliding sleeve valve engine recently under test at the hands of the Automobile Club of America is of considerable interest inasmuch as a new world's record for continuous operation was established. The motor actually ran a total of 336 hours with the throttle wide open and the dynamometer load adjusted to hold the revolutions to 1,117 a minute. The average horse-power developed, the bore and stroke being 4 and 6 inches respectively, was 38.3; maximum horse-power developed on a subsequent test was 53.6 at 1,682 revolutions per minute. The gasoline consumption during the test was 1,744 gallons, though this figure, unfortunately, is inaccurate for the reason that an undiscovered leak in the fuel line increased the consumption. The average consumption during the time when, presumably, there was no leak was 31.5 pounds an hour, and during the last 10 hours this dropped off to 30.8 pounds. The gasoline tested 61.6 Baumé at 60 deg. Fahr. All told, 131.6 gallons of lubricating oil were used. At the conclusion of the run, the motor was found to be mechanically perfect and unusually free from carbon deposit; the sleeves and ports were free from burns and the piston rings were free. Throughout the run no trouble of any kind was experienced, except that the fan belt broke, and after being replaced once, finally was discarded after it again failed.

The Electrically-operated Brake Appears.—There has just been placed on the market—it was exhibited at the recent automobile show in Grand Central Palace—a novel and interesting mechanism for electrically operating the emergency brake on automobiles. Briefly, the apparatus consists of a tiny electric motor operating at extremely high speed and driving through worm gearing a drum over which a cable attached to the brake actuating mechanism is wound. The motor draws current at six volts from the battery used for the electric engine starter. The control is placed on the steering column and is one of the most interesting parts of the whole assembly. When the lever is moved so as to close the circuit and open it again immediately, the electric motor is set in motion, but the movement of the drum is limited by the action of an automatic circuit breaker which cuts off the current when the drum has made a predetermined part of a revolution. As the drive is through worm gearing, the brake cannot release itself and remains lightly applied. Subsequent movement of the control lever in the same manner repeats the process, applying the brake still more tightly and a further repetition of the initial function permits further revolution of the drum, applying the brake with the maximum pressure. A friction clutch between the motor and the drum protects the cable from breaking. The brake may be released progressively, as it is applied, or at once. Similarly, moving the control lever the limit of its travel applies the brakes to the maximum pressure almost instantly. The apparatus may be applied to any car, new or old.

The Scientific American "Safety First" Medal

The Five Winning Devices

By William H. Tolman, Ph.D., Director of the American Museum of Safety

As early as 1867 Dolfus, a French industrialist, aroused by the increasing number of accidents to labor in factories and workshops, due to the fact that there was little or no attention paid to the safeguarding of dangerous machinery, organized an association for the prevention of accidents, and founded what was the beginning of a museum of safety devices. To-day some of these original models may be seen in an honored section of the Paris Museum of Safety Devices. In 1890 a museum of safety devices was opened in Vienna; in 1893 a second in Amsterdam, followed by similar organizations in Munich, Berlin, Moscow, Zurich, Paris, and Milan, until now there are twenty-five museums of safety.

One of the most encouraging signs of the moral uplifting of the race is the unmistakable growth in these later days of the humanitarian sentiment. The dignity of the human body, the sanctity of human life, are swiftly emerging to their full and proper recognition. The reproach has lain too long at our doors that, as a people, we were so madly bent on the pursuit of wealth that we cared little who might fall by the way, if only the goal were swiftly and grandly won. To the question: "How much then is the life of a man worth more than a sheep?" we have made answer by rolling up a record of over half a million annual maimings and killings that may well put us to the blush. Therefore it is gratifying to realize that the movement set on foot by the American Museum of Safety for the promotion of an American museum of safety devices is meeting with marked success.

After seven years of vicissitudes the Museum has emerged as a great institution for promoting safety. The work of the Museum has often been commented upon in the SCIENTIFIC AMERICAN.

To further stimulate the prevention of accidents and the promotion of industrial hygiene, five gold medals are placed at the disposal of the American Museum of Safety for annual award. Three of these are in general fields. One, the E. H. Harriman Memorial Medal, founded by Mrs. E. H. Harriman, will be competed for by American steam railways, for the best record in accident prevention and hygiene, affecting the public and its own personnel, during the current year. A fifth medal, known as the Rathenau Gold Medal of the Allgemeine Elektricitäts-Gesellschaft of Berlin, is to be awarded for the best device or process in the electrical industries, safeguarding industrial life and health, made through an American institution. The last award in the series will be the Anthony N. Brady memorial medals.

The oldest medal is that given annually by the SCIENTIFIC AMERICAN, and, therefore, it is fitting that in a special number devoted to "Safety First" we should review the five awards which have been made of it.

In 1908 the award was given to a device for safeguarding life at sea. Fire on shipboard is as much a crowning horror as a collision, and any means of detecting it and putting it out should be added as equipment to all vessels. The award was made to the Rich Marine Fire Indicating and Extinguishing System.

A brief description of the device will prove of interest. A pipe runs to each hold, storeroom, bunker, etc., where it terminates with a flat cap or smoke collector. The pipes from the various holds and bunkers are assembled from fore and aft and are carried to the bridge or to the wheel house. Here they are arranged in banks in a case, which is practically air-tight. Each pipe has a removable smoke spreader bearing a number. Directly over the pipes is an electric fan which can be actuated continuously or at intervals. In front is a clock provided with means for making contact with an electric bell every fifteen minutes. It is the duty of the officer of the watch to set the motor in motion if it is not running continuously, and to look through the glass front at the pipes. Very little suction is necessary to draw the smoke from any incipient fire, and it is readily detected with the aid of the electric light which is inside the case. If no fire is found the officer "rings in" on a time clock like a watchman's detector, showing that he has made the proper inspection.

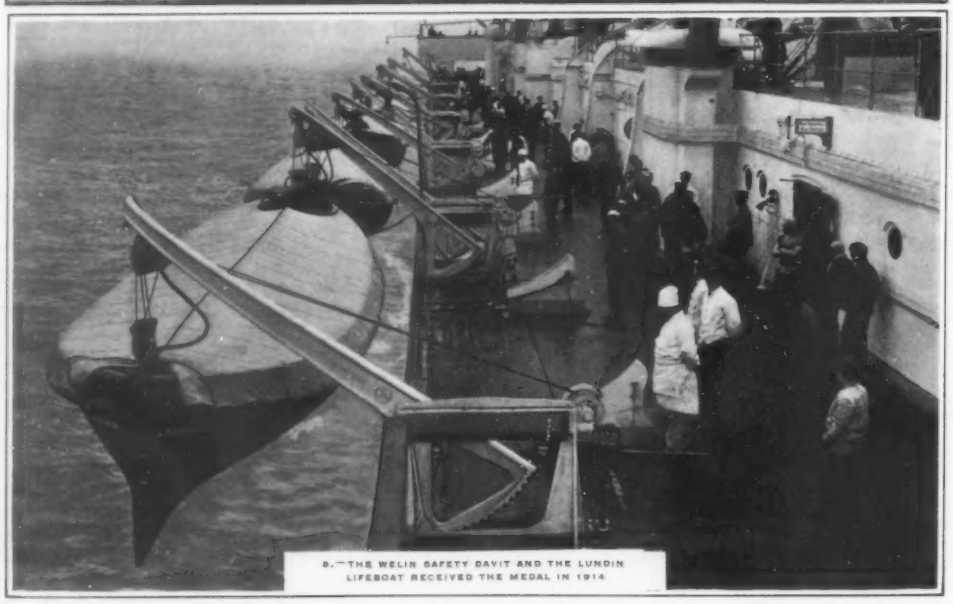
In 1909 there was no award, but in 1910 the SCIENTIFIC AMERICAN Medal was given to the Patent Scaffolding Company of New York for the design and construction of masons' suspended platforms. The following is a brief description:

The construction will readily be understood by reference to the engraving. The scaffold is interrupted so as to make sections ten feet long. At the ends of each section of planking are a pair of winches secured to a horizontal iron beam serving to support the planks. The winches are composed of a drum around which wire rope is roved, and the necessary supporting members. The upper end of the wire rope is secured to an outrigger by an anchor bolt, thus serving to support the scaffold. To the drums are secured ratchet wheels. A lever serves to actuate a pawl, which raises or lowers the scaffold by means of the ratchets which serve to turn the drum which winds up the cables. As the sections are small, one man can raise his section very quickly by a few strokes of the four levers at each corner.

1911 passed without any exhibit being made which was worthy of the medal, but in 1912 it was awarded to the Norton Company for their well-developed and carefully thought out accident prevention devices applied to grinding wheels. The company has at all times made an effort to fool-proof in every possible way all apparatus of its manufacture by means of safety hoods, flanges, etc. In addition to the specially referred to safety devices, accidents from other sources have been guarded against, by means of proper housings of all gears or other pieces of mechanism, also stops which prevent the mounting of a larger wheel than the given machine has been designed for; dust suction systems for the protection of both operator and machine; leather spark brushes, so attached to the hood as to protect an operator's clothing from sparks; adjustable rests, etc. In 1912 the SCIENTIFIC AMERICAN Medal was awarded for the fourth time. This year it went to the Draeger Oxygen Equipment Company for their "Pulmotor," which possesses such human interest for the many lives it has saved in cases of gas poisoning and electric shock as well as drowning.

The cylinder contains 11½ cubic feet of pure oxygen. The oxygen passes from the reducing valve to an injector which has the property of drawing in a large volume of air with a certain force of suction, and propelling that air forward with equal force through the flexible tube in front of the injector. This suction and delivery injector, therefore, serves as a motor, alternately filling the lungs by pressure and emptying them

(Concluded on page 130)



The Scientific American Medal and the devices for which it has been awarded.

The Business Side of the "Safety First" Principle

How Accident Prevention Pays

By David S. Beyer, Manager Accident Prevention Department, Massachusetts Employees' Insurance Association

ANYONE who visited the recent exposition of Safety and Sanitation at the Grand Central Palace in New York, must have been impressed, especially if he were previously unfamiliar with the scope of the safety movement in the United States.

Even those who were best acquainted with what is being done all over the country for the prevention of accidents, could not restrain their expressions of surprise that so much safety material from so many varied sources could be gathered in a single exhibition hall. It reminded one of an annual automobile show, in the variety of equipment represented and the enthusiasm with which the proprietors of the various booths displayed their exhibits to visitors.

To be sure, some of them had an eye to business; the man who broke dollar goggles for all comers just to show how strong they were, undoubtedly expected to recoup his losses through future orders. This, however, could not be the controlling motive that induced Germany and Holland to send their contributions from across the seas, nor did it influence the United States Steel Corporation, the New York Edison Company, the Westinghouse Electric Company, the Pennsylvania, Chicago and Northwestern and Baltimore and Ohio Railroad Companies and scores of others who do not manufacture safety devices for sale.

Anyone who came away without realizing that the safety movement is on in earnest in this country must have kept his eyes shut and his ears closed.

Ten years after Spain passed her first workmen's compensation act, we began to adopt similar acts in an effort to correct the long standing wrong.

Germany made the start thirty years, and England fifteen years ago.

But when we move, we move quickly. With the safety movement scarcely six years old in this country, we can point to hundreds of plants which are equal, if not *superior*, to the best in Europe as regards the safety of their employees. And the list is constantly growing.

During that time we have proven several things: in the first place, that *accident prevention pays*. By this is meant not only that it pays from the humanitarian standpoint, but that it is a good investment looked at in terms of cold cash.

The Economy of Accident Prevention.

This is not the only object that appeals to a business man, but it is a very important one; he must run his business economically, or it will become impossible for him to continue in business. It can now be demonstrated that one of the most effective economies he can introduce into his plant is scientific accident prevention.

Take for example the appended chart of the United States Steel Corporation, giving the results of six years of safety work; this shows a reduction of forty-three per cent in the accidents to employees during that period; stated in terms of human units, this means that nearly nine thousand men were saved from death or serious injury.

With the compensation of injured workmen costing a million and a half dollars a year, it takes little further calculation to show that the million dollars per year which the corporation has invested in safety devices is paying several times as much as if it had invested the same amount in Government bonds.

And that is only the *direct* saving, to which several incidental items can be added. An accident to a trained worker generally means that a "green" hand must be employed to fill his place. It costs money to break in a green man, and in doing so further loss is generally involved, through the reduction of output and the spoiling of more or less good material. Furthermore, this man, being unfamiliar with the hazards in his new work, is likely to injure himself or some of his fellow employees before he is fully trained. Still another possibility of loss confronts the employer. The new man may after all prove unsatisfactory for the work, and have to be replaced by a third man, thus doubling the training expense.

TRIMS DOWN HAND DAILY ON BUZZ SAW
CIRCULAR SAW HOODOO FOR DOLAN
FELL AGAINST A BUZZSAW.
FATAL DAY FOR MILLWORKERS
AN AWFUL DEATH
NEARLY CUT IN TWO, BOY STILL LIVES
CIRCULAR SAW CUTS THROUGH MAN'S HAND
AMPUTATION OF MEMBER IS NECESSARY.
A PAINFUL ACCIDENT
HAND IS CUT OFF
STRUCK ARM ON A CIRCULAR SAW
AND SEVEN STITCHES WERE RE-
QUIRED TO CLOSE
RECEIVED
FOUR FINGERS CUT BY CIRCULAR SAW
BODY SPLIT OPEN BY SAW
BOY DEMANDS $10,000 FROM BOX COMPANY
Gerber Falls on Circular Saw
FINGERS CUT OFF IN CIRCULAR SAW

Newspaper reports that would not have been published if the "Safety First" principle had been observed.

DANGER
MEN ABOVE.
W. A. FIELD, GEN'L. SUP'T.
DANGER
DO NOT STAND AT THIS END OF THE HOT BED.
DANGER
MEN IN CAR.
STOP THIS MACHINE BEFORE REPAIRING, OILING OR WIPING.
SHUT OFF EMERY WHEELS WHEN NOT IN USE
DANGER — KEEP OUT.
NEBEZPECNO — NE CHOC DNUKA.
OPAZNO — NE IDA UNUTRA.
VESZÉLY — TILOS A BEMENET.
NIEBEZPIECZEŃSTWO — NIE WOLNO WCHODIT.

Some signs to be found in American Steel Works.

It is impossible to estimate these items of cost accurately, but no one can deny that they exist in definite form and that this expense can be saved by avoiding injuries to trained employees.

The Chicago and Northwestern Railway Company has not been working at accident prevention so long as the United States Steel Corporation, but, nevertheless, shows a reduction in accidents for the last three years of 20.9 per cent in the number of persons killed and 23.7 per cent in those injured as compared with the last year previous to the organization of safety committees.

The fact that such committees have been organized in sixty-eight railroad companies, including such systems as the Buffalo, Rochester and Pittsburgh, Chicago, Burlington and Quincy, Chicago Great Western, New York Central, Pennsylvania, Norfolk and Western, Southern, and Union Pacific, etc., indicates how thoroughly convinced the officials of these great organizations are that safety work pays.

The accident reductions which have been obtained by the Eastman Kodak Company may be mentioned as characteristic of another type of industry. As a result of two years safety campaign, decreases in accidents aggregating 44 per cent have been made, as shown by the table on the next page.

Many other cases might be cited, but these are sufficient to show the possibilities of this work.

Workmen's Compensation Acts and Accident Prevention.

In considering the saving effected by cutting down accidents, it should be remembered that this item of expense has been growing larger year by year. During the last three years about half the States in the Union have passed workmen's compensation acts, the immediate effect of which has been to multiply by several times the cost of accident settlements.

It is probable that within a short time all States will have similar laws, so that the question becomes much more important financially than it has been in the past, on account of this increase in cost.

The principal way in which this loss can be cut down is by preventing the accidents. When it becomes generally recognized that 30 per cent to 50 per cent of all industrial accidents are preventable, some by mechanical safeguards and others by educating the men not to take chances, a great step will have been taken toward bringing about the desired end.

It must be admitted that as a rule it is the small plant that is the hazardous one, and it is the proprietor of the small plant who is the hardest to convince that safety work is needed. Generally he has heard of numerous accidents occurring in the big plant across the way, and is quite ready to concede that safety work is a prime necessity there, but he feels that conditions are different in his own plant. He has very few accidents, and when one does occur it is the fault of the injured man himself.

He does not stop to think that the reason why there are more accident in his neighbor's plant than in his own, is because it is so much larger, and that in reality he may be having more accidents

in his small plant in proportion to the number of men employed. A small plant may go for months or even years without an accident, just as a department of the same size in a large plant may have the same experience; but where several thousand men are working in any industry, a number of accidents are sure to occur every week.

The mistaken idea comes in trying to form a general opinion from a limited field of observation. A wide experience and the knowledge of thousands of accidents are necessary before it is possible to recognize what accidents are common and may be expected to reoccur.

An Insurance Company's Experience.

By way of illustration, the experience of an insurance company covering about nine hundred plants may be cited. During the course of a year there were ninety-six accidents reported from persons falling down stairways. At the same rate of frequency, it would be ten years before this particular accident would occur in each of the nine hundred plants. It is altogether probable that before the end of ten years the first accident would be forgotten, or, even if it should be remembered, those most familiar with the accident conditions would be likely to say that since this kind of accident happened so seldom, it was not worth considering.

As a matter of fact, one hundred accidents from one cause, even in a thousand plants, shows that this is a serious source of hazard, and one which would warrant the expenditure of considerable sums for hand-rails, safety treads, additional lights, etc., by means of which many of the accidents could be prevented. When this is made clear, the safety provisions are usually forthcoming.

Another element which explains the reasons why many people may consider an accident rare and unusual when in reality it is common and of frequent occurrence, is the general tendency to hush up information of this sort as completely as possible.

An accident is an unpleasant thing at best, and everyone likes to forget about it as soon as possible. Thus it sometimes happens that men in the building next to the scene of an accident know nothing about it. The same accidents may be happening all around them, yet when one comes under their personal observation, they consider it a strange and unique "Act of God."

Not long ago an inspector was talking to one of the officials of an electric company about the protection of 500-volt electrical equipment. This official was in a position where he should have been familiar with all the details of the subject as far as his particular company was concerned, having been connected with it for a number of years; yet he remarked, "To my knowledge no one has ever been killed in this company from five hundred volts."

The inspector replied, "To *my* knowledge two men have been killed from this voltage in your own company during the past two years."

This official had not heard of the accidents because, as is common practice, they were kept quiet. When such ignorance of accident conditions exists within a single company, it is not strange that the people in one plant should not know about the accidents in others. Thus the proprietor of the small plant fails to have any conception of the great number of accidents that happen in the industries about him, and the part that he can play in reducing his small proportion of the whole.

It is an unfortunate thing that there must be accidents, but when they do occur, it is still more unfortunate if the one valuable result is lost: this result is the lesson which might be learned from one accident, to the end that other accidents of a similar nature might be prevented.

One of the things that is very much needed is greater publicity as to the accidents which occur, and the manner in which they occur. The records published by the various States, with two or three notable exceptions, are so vague and indefinite as to be of no value whatever from this standpoint; one of the important aims of correlating the various safety movements in different parts of the country, should be the accumulation of accurate statistics, classified along uniform lines, and giving sufficient detail to convey a definite impression as to the exact causes of the vast number of accidents occurring every year.

The pioneer work in accident prevention has been done. It has been demonstrated that accident prevention pays from the financial standpoint, as well as from the more important aspect of humanitarian considerations. The way in which accidents may be prevented has also been well marked out, and is constantly being more clearly defined. What is now needed is widespread publicity, so that every man in every industry in our country may know the advantage of this great movement, and do his part to carry it forward.

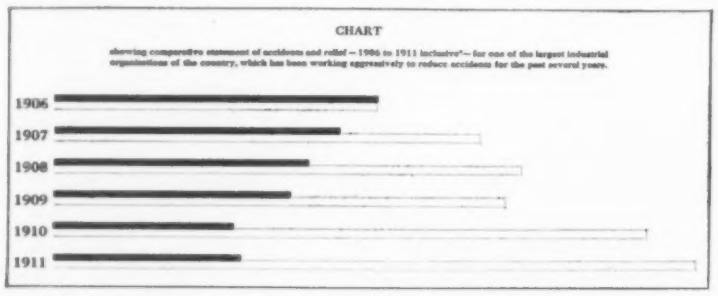


CHART
showing comparative statement of accidents and relief — 1906 to 1911 inclusive*— for one of the largest industrial organizations of the country, which has been working aggressively to reduce accidents for the past several years.
1906
1907
1908
1909
1910
1911

Heavy lines show reduction in serious and fatal accidents among employees of the United States Steel Corporation, using 1906 as a basis. Dotted line shows increase in total casualty expenses per employee, using 1906 as a basis. The increase is explained by the fact that the corporation in question has made more and more liberal payments to its injured men, until, in 1910, it adopted a voluntary compensation scheme, in which all men injured in the regular course of their employment are compensated, regardless of whether they were partially to blame for the accident or not. The slight increase of serious and fatal accidents in 1911 over 1910 is due to a change in classification of accidents established January 1st, 1911, resulting in more accidents being classed as "serious" than formerly were so classed. The fatal accidents in 1911 were 27.27 per cent less than in 1910. During 1910 and 1911, $3,133,000 was expended for compensation to injured workmen, and $1,750,000 for the installation of safety devices. *The number of serious and fatal accidents shows a decrease of 43 per cent since 1906*, thus indicating that the large expenditure for safety equipment was amply justified, and gave a good return on the investment.

COMPARATIVE STATEMENT OF ACCIDENTS PER 1,000 EMPLOYEES FOR THE YEARS 1910, 1911 AND 1912.

Nature of Accidents.	Rate per 1,000.		
	1910	1911	1912
Fingers and hands between punch presses and shears	14.38	9.28	4.30
Fingers and hands against woodworking saws	4.79	4.41	2.69
Fingers and hands into woodworking cutters	2.13	2.32	1.25
Bruises, burns, lacerations and injuries of minor importance	44.74	33.41	27.97
Falling off ladders, platforms and slipping	10.91	6.26	6.45
Injured around elevators	.80	1.39	.72
Injured around emery and other grinding wheels	3.46	1.16	1.61
Obstructions in passageways and doors	.53	.46	1.25
Falling tools, materials, etc	9.59	7.42	4.66
Fingers and hands under drilling and boring machines	8.53	1.86	3.41
Fingers and hands into automatic screw machines	1.07	.70	.90
Injured around lathes and milling machines	4.79	.46	.72
Stepping on nails	4.00	2.55	3.05
Injured on machines of special nature	.....	.....	2.15
Total accidents per 1,000 employees per year	109.72	71.68	61.13
Reduction of accidents per 1,000 employees since year 1910	.....	38.04	48.59
Percentage of reduction	.....	34.67	44.29

A Wireless Danger Aboard Ship

THAT wireless may at times prove dangerous aboard ship, has just been pointed out by the United States Bureau of Navigation, Department of Commerce, part of whose duty it is to see that the laws governing the use of wireless telegraphy are obeyed. The same wonderful means of communication which already has saved the lives of so many at sea, may result, if not properly guarded, says the bureau, in a danger and a menace rather than a safeguard to some vessels.

The bureau is preparing to call the attention of the entire shipping world to this danger, and through its inspectors to warn them. The danger is that electrical sparks may set fire to vessels carrying gasoline or other substances which generate an explosive gas.

In a communication which has just been sent out to radio inspectors by A. J. Tyrer, acting commissioner of the bureau, the following statement is made:

"When inspecting the radio apparatus on tank vessels or cargo vessels carrying gasoline or similar substances which generate an explosive gas or any other explosive which might be ignited by electric sparks caused by the operation of the radio apparatus, you will pay particular attention to the insulation of the antennæ, to metallic rigging or equipment of the vessel in which currents may be induced by the action of the radio apparatus, and to the wiring and electrical equipment of the vessel in which currents may be induced by radio apparatus so as to cause sparks to jump between wires or between small gaps.

"In general this matter should be brought to the attention of masters of vessels, steamship owners and wireless telegraph companies.

"If upon inspection sparks of the above character are found, the matter will be reported to the master of the vessel, the steamship company or its agents, and to the company operating the wireless apparatus, and the dangers pointed out."

The operation of radio apparatus on board vessels generates in the antennæ enormous potentials or very high voltages. If the insulation of the antennæ is in any way defective, this high potential causes sparks of electricity to pass over the insulator in an effort to reach ground. In some cases, even though the insulation is efficient, high potential surges are generated in metallic rigging, such as guys, etc., by electromagnetic induction. Small insulated spaces or air gaps are sometimes found in parts of a vessel's rigging in the vicinity of steel guys, etc., and the high potential surges induced in these conductors often jump across the gaps in the form of electrical sparks. It is a very common occurrence on board vessels when the wireless apparatus is operating to hear the crackling of small sparks aloft, or sometimes at night these small sparks can be seen. In many cases special precautions are taken to avoid this phenomenon, and the guys and rigging are split up into insulated sections in such a manner as to be out of resonance with the radio apparatus so that the surges cannot take place.

Many tank vessels and some of the cargo vessels carry gasoline or similar explosive material and are equipped with wireless apparatus. In some cases vent pipes from the storage tanks are led up the masts and have openings in the vicinity of the antennæ or some of the guys where electric sparks might occur due to the radio apparatus, and it is entirely within possibilities to assume that under certain conditions the sparks might cause an explosion. It is well known that gasoline vapor in explosive engines is ignited by means of electrical sparks which are identical in every particular with the sparks above described.

Oil and Wool from Pine Needles

PINE-NEEDLE oil is a product derived from the leaves of our pines. It has been extracted for a great many years and is well known the world over as a remedial agent against rheumatism and allied complaints. It is a volatile, colorless liquid obtained by distillation of fresh needles, young twigs, and one-year-old cones of our western and southern yellow pines. In order to produce oil of the best quality fresh green needles must be collected during the spring of the year, preferably in the beginning of June. Pine-needle pickers go from tree to tree and select the young, thrifty green leaves at the ends of twigs, which yield about 0.55 per cent of volatile oil. Those of old trees, which are dry and tough, produce much less and of much poorer quality.

A number of years ago this oil was supplied by a number of small stills or ordinary pharmaceutical distilleries. The still itself is a very simply constructed apparatus consisting of a closed copper kettle, into which the material is placed. Steam is admitted under pressure and passed through the contents from the bottom of the kettle. The volatile oil is vaporized by the dry steam and passed off with the saturated steam through a long coiled condensing tube. The condensed steam and oil are collected in a receiver, and the oil, which is on top, is drained off.

There has been an increasing demand for pine-needle oil and the small stills which could not compete with the larger concerns have now practically all ceased to operate. The large distilling plants with all the recently introduced secret devices are now able to produce all the oil required for home consumption and also for export. In this way the oil has not only been improved, but the cost of production has been considerably diminished. Some of the large stills have a capacity of from 30,000 to 60,000 gallons annually. The price of the purified oil varies from $20 to $30 a gallon. Cheaper oils are frequently adulterated with turpentine oil.

The mass left in the kettle after all the oil has been driven off may be regarded as a by-product, and it is sometimes due to the close utilization of this material that the business is made a profitable one. The needles are removed from the kettle and boiled in a soda solution until all the resinous matter and non-fibrous tissue are separated from the fibers. It is next passed through a series of washing, drying, and heating processes, which sometimes require 24 hours. After they are put into a machine to separate and loosen the fibers, they are bleached and put in assorted packages and sent to the different markets, where they are sold for pillow and mattress stuffing. The fiber will retain its odor permanently and is considered very healthful and vermin-proof. It was on account of these two qualities that the best hotels and hospitals of Europe used this fiber in their mattresses.

The material when properly prepared is sometimes known as pine wool which may be spun and woven into fabrics. It is very strong and is advantageously employed for many of the purposes for which hemp is used. In Europe this pine wool is made into jackets, drawers, and stockings of every description as well as flannel for shirts, coverlids and chest protectors. Knitting and darning yarn, quilts, wadding, deafening paper for walls and floors, and a great many other articles are manufactured from this wool.

Correspondence

[The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.]

Labor in South America—a Word of Warning

To the Editor of the SCIENTIFIC AMERICAN:

Now that the Panama Canal is nearing completion, a number of American workers will be ripe for a change of scene. They have been receiving good wages and will have money in their pockets. It is probable that the love of travel and change will lead some of them to South America; in this connection a word of warning is due.

I am writing from Colombia—the country nearest to Panama—a country which is, in popular belief, the El Dorado of miners; a country in which several railroads are in operation and in course of construction; and one which has recently come into notice in connection with oil and other concessions.

The American or European firms operating in Colombia usually engage white employees from home, under contract. There is therefore small chance for the man who casually drifts into camp. One difficulty is the extent of the country—more in difficulty of travel than in actual miles. A man on first landing at Barranquilla or Cartagena finds workmen who do not object either to hard work or long hours, earning from 40 to 60 cents a day. He learns that up country are mining camps staffed with white men, and probably decides to try his luck. The only road is on the river Magdalena, on steamboats traveling about six miles an hour. When the moon is full these boats travel (or may travel) full time; at other times they often tie up to the bank during the dark hours. The journey may therefore take four days or more than a week. On leaving the boat a spot is chosen where a feeder railway runs something less than a hundred miles into the country, and from there travel is over roads such as are unknown in the wildest of the northern Rockies. Local transportation is on mules, but this is expensive for a man who is not a native, probably with a slight acquaintance with the language and not conversant with the customs of the country. He will soon learn one custom which is prevalent though not universal, the habit of charging foreigners double what is charged to a native. The mining camps may be fifty or more miles apart, or several days measured by time of travel, over roads which are a succession of steep climbs or descents, in a country of perpetual summer heat, the only division of seasons being wet and dry. At the camp he finds the usual men under an agreement from home. If he is an artisan, a blacksmith or carpenter, he may get work at something slightly under a dollar a day. This is enough to live on, but not enough from which to save a stake with which to reach home. If he is unsuccessful he drifts to the next camp, there to repeat the experience.

The native Colombian is a very adaptable man, and he is clannish. Therefore we find the railroads manned by natives and little chance (as there is said to be in the Argentine) for American engineers.

I have been prompted to this warning because the procession has already commenced. Men are reaching this camp at the rate of one a month. So far they have been entertained for a day or two and helped on their way. This is not pleasant for men anxious for work, and if the stream increases the scattered camps will not feel able to do as much as they do now.

It should not be overlooked that the tendency in seeking work is to drift farther into the country, and that the difficulty of working back to the coast is great.

A man "on his uppers," willing to do "anything," has not the scope which he has at home, for good labor is content with 50 cents a day. I have miners working at this figure, and the work is much sought after. They work from six to five, often up to their knees in water, with only forty minutes for rest and food, under a hot sun. And it is actual hard, muscular work.

Colombia is a country of great resources and many possibilities, and far from fully developed. There are openings here, but there are more openings anywhere in America. And an American from Panama is not likely to wish to settle here in one spot to slowly and laboriously carve out a mere "good living" for himself.

From inquiry—not from personal knowledge—I gather that Venezuela is on a par with this country. Of the other South American countries I know little. But before taking a journey south an American worker will be wise if he obtains from some reliable source particulars of the conditions prevailing in the country he thinks of visiting.

W. E. WARD.

Medellin, Colombia.

A Problem in United States Coins

To the Editor of the SCIENTIFIC AMERICAN:

Here is a little problem in figures that may be of some interest to your readers. Having for many years handled the shipments of coin from this mint, I have observed many combinations. The following however is most peculiar and will give your readers something to work over. Perhaps some of your readers would give an algebraic formula for the solution. How can 200 coins of the United States (present coinage) be so divided as to total $500. Every coin must be used at least once. Coins now minted are 1-cent, 5-cent, 10-cent, 25-cent, 50-cent ($2½, $5, $10 and $20 gold).

THEODORE L. DELAND, *Shipping Clerk.*

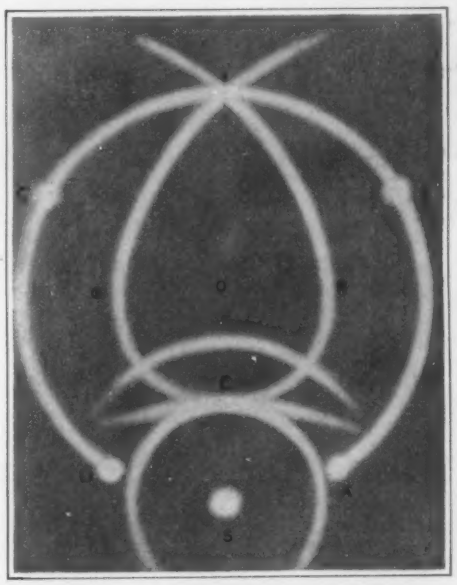
United States Mint, Philadelphia, Pa.

Halos and Sundogs

To the Editor of the SCIENTIFIC AMERICAN:

On the second day of November, 1913, there was manifested in the sky a very complete set of halos and sundogs. They were seen here in Richmond and probably in a considerable area, for several inquiries were received by the railway companies from their station agents out on their lines as to the cause of the phenomena.

I first noticed the phenomena about noon, and they remained visible several hours. The most marked object was a large circle about thirty degrees above and concentric with the horizon. It was white and about the width of the full moon. On this circle there were four bright chromatic nodes, marked on the accompanying drawing *A, B, C, D*. About the sun there was a marked but not unusual halo strongly chromatic at the point *E*, and gradually fading away toward each side as shown. There was a second concentric circle at *F*, also chromatic. From the point *E* tangents extended out on each side as shown. Perhaps the most unusual part of the picture was the lines *IG* and *IH*. They were white, about the same width as the large circle, and very clearly seen from *I* to *G* and *H*. Beyond *G* and *H* they became very faint, but seemed to curve in to the point *E* as shown. On the attached sketch *S* represents the sun and *O* the zenith.



A complete set of sundogs and halos.

I suppose all these phenomena are due to the refraction of light from minute particles of water or ice in the higher atmosphere, but the detailed explanation of how such peculiar lines as *IG* and *IH* as well as the tangents at *E* are produced is beyond me.

The day was beautiful, an ideal autumn day; cool and clear with a slight haze in the air and a bit of herring-bone effect in the sky at times. There were no clouds except very low down, and the geometrical designs traced in the sky were very striking. With some crude instruments Dr. Hopkins and I measured the angles as best we could, and the drawing is fairly accurate.

I shall be pleased to have you make such comments and explanations as you may wish.

Richmond, Va. E. C. L. MILLER.

[Dr. Miller may congratulate himself on having seen a most striking and rare phenomenon. On November 1st and 2nd, 1913, a large area of high barometric pressure—an anticyclone—was drifting sluggishly across the eastern half of the United States. Over extensive regions of the country the sky was lightly veiled with cirro-stratus cloud. Evidently the air at this cloud level was in a very unusual state of tranquility, making possible the occurrence not only of the common varieties of halo, which do not depend upon any particular angular position of the ice crystals in the atmosphere, but also those rarer halos which can occur only when the crystals are falling in a horizontal position. Complicated and beautiful halos were seen at many places in the States of the Mississippi Valley on the 1st, and in the Atlantic States from Maryland southward on the 2nd. The phenomena appear to have reached a particularly high state of development in southern Virginia, though those seen the previous day at points in Missouri and Arkansas were no less remarkable.

The lines marked *IG* and *IH* in the drawing, known as the "oblique arcs of the anthelion," are especially rare. The theory of these arcs has never been satisfactorily worked out, though they are supposed to be connected with striations on the faces of the crystals.

The nearly horizontal arc tangent to the lower halo at *E* is the "upper tangent arc of the halo of 22 degrees." With increasing altitude of the sun above the horizon the ends of this arc bend downward until it finally becomes an ellipse surrounding the 22-degree halo. It is then called the "circumscribed halo" and was seen in this form at several places on the dates in question.

All the halo phenomena shown in the drawing, and many others, are described in Mr. C. Fitzhugh Talman's article "Solar and Lunar Halos," in the SCIENTIFIC AMERICAN SUPPLEMENT of November 16th, 1912.

It seems probable that if all the observations of the halos of November 1st and 2nd should be collected it would be found that some observers were treated to sights rivaling the historic "Petersburg phenomenon," of 1790, which has heretofore ranked as the most wonderful halo ever seen, except, perhaps, in the polar regions, where complicated halos are fairly common.

We take this opportunity of thanking other correspondents who have sent us reports and drawings of these halos.—EDITOR.]

Positive and Negative Natural Laws

To the Editor of the SCIENTIFIC AMERICAN:

In reading the editorial, "Positive and Negative Natural Laws," volume cx, No. 2, I was impressed with the fact that the principles therein stated work out very well in our everyday life.

The good that is to come, the profits which are to result from working for a cause, for standing firm in tight corners, are not always evident. There is no positive law which says that there is a satisfactory reward for every worthy effort; credit for a scientific discovery may never be given to the right workers, the probable results of any particular research cannot always be foretold, or again there is no certain benefit which is positively obtained by all who respect and use natural laws.

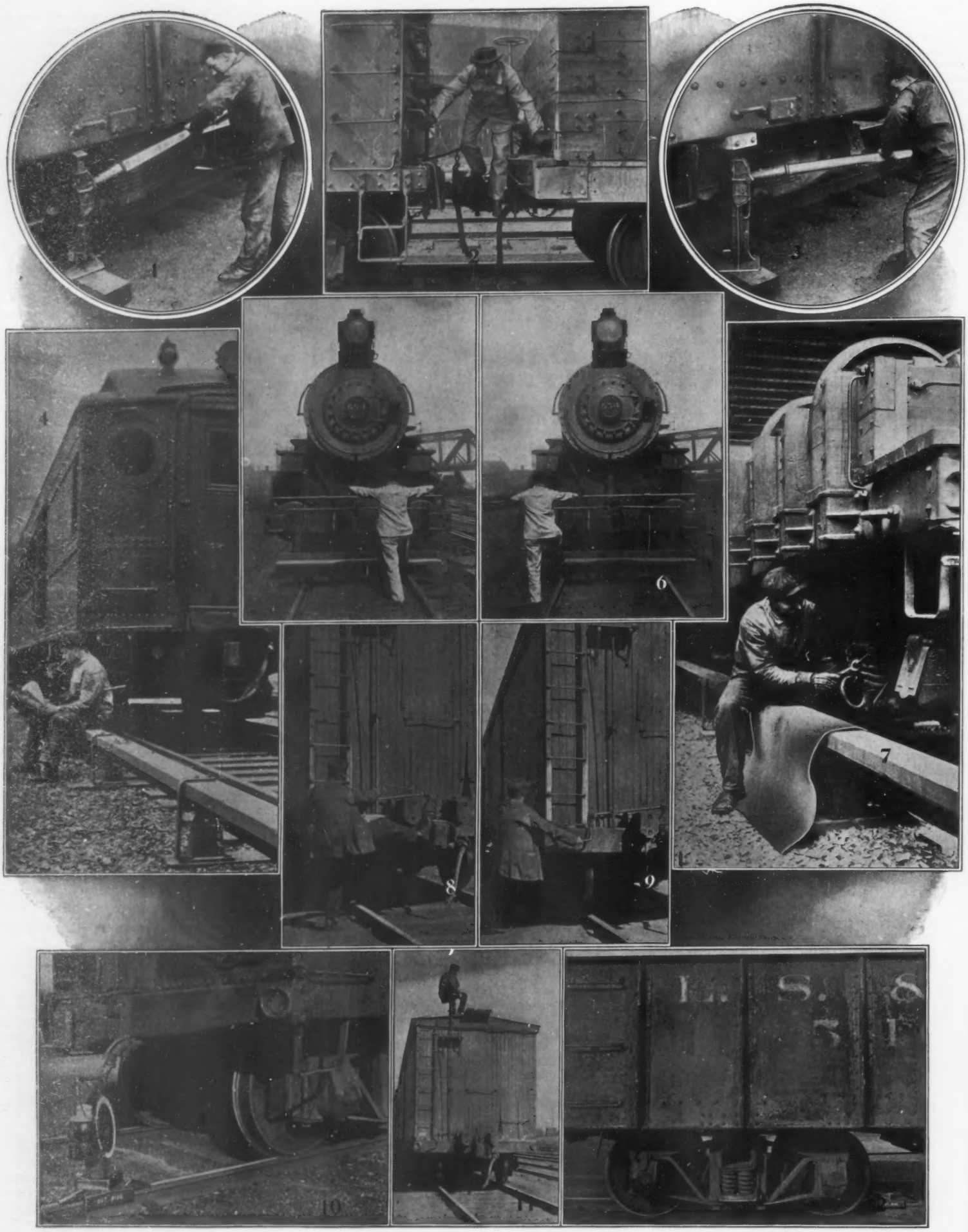
The negative causes and results, however, seem obvious. The losses, hardships, or difficulties are certain to arise from not guarding an exposed belt, not disclosing a useful discovery, not respecting natural or approved artificial laws, not conserving national resources, or other negative conduct. We do not know what electricity is, yet we are not ignorant of its existence, laws, and uses. Even the commandments are negative admonitions. Certain it is then, that negative laws are of universal application; they are in fact often more powerful and useful than positive statements would be.

PHILIP E. EDELMAN.

Minneapolis, Minn.

Earthquakes and the Panama Canal

DR. CHARLES DAVISON, the leading English seismologist, discusses this subject in the *Geographical Journal*, and comes to conclusions almost as reassuring as those reached by Mr. D. F. MacDonald in his article in the SCIENTIFIC AMERICAN of October 18th, 1913. He gives three reasons for thinking the danger from future shocks to be slight, viz., the fact that only three earthquakes, including that of last October, have attained even a semi-destructive character in the present Canal Zone since the time of the Spanish conquest; that, as pointed out by Mr. MacDonald, the canal is remote from mountain ranges and does not traverse any important faults, so far as known; and, lastly, that even if a violent earthquake should occur it would probably have no more disastrous effect on the canal than to cause landslides from the sides of the cuttings, as the researches of Milne, Sekiya and Omori have proved the destructive vibrations of earthquakes to be confined chiefly to the surface of the ground and to extend only in a slight degree to the bottom of a deep artificial excavation. All three arguments are, however, qualified; the first by the fact that violent quakes have sometimes occurred in regions previously exempt (e. g., in the Colchester district of England, in 1884, and at Charleston, S. C., in 1886); the second by the fact that deep-seated faults, capable of giving rise to severe earthquakes, often exist in places where the surface conditions give no indication of their presence; and the third by the consideration that landslides caused by a violent earthquake, if they should occur after a prolonged period of heavy rain (a very probable event on the Isthmus), might themselves constitute a serious calamity.



1. This picture shows the method of instructing employees adopted by the New York Central Lines. It illustrates the improper way of using a jack without proper blocking. Thus used, a jack is apt to slip out and cause injury to the man using it.

2. Climbing over drawbars of cars to save walking around. A dangerous practice, since the cars are apt to be moved without warning. (New York Central Lines' method of instructing employees.)

3. Contrast this picture with picture No. 1. It shows the proper use of a jack with blocking at the top and bottom. Bolts run through the cross grain of the blocking to prevent it from slipping. (New York Central Lines' method of instructing employees.)

4. Flagging his train. The third rail makes a comfortable seat, but who protects the train? (The Pennsylvania Railroad Company's method of instructing employees.)

5. A common practice which is extremely hazardous. The employee is standing between the rails and getting on the foot-board of a locomotive as it approaches. Contrast this picture with No. 6. (New York Central Lines' method of instructing employees.)

6. Contrast this picture with No. 5. It is safer to stand outside of the rail on the engineman's side, where there is less danger of serious injury if the employee misses his footing. (The New York Central Lines' method of instructing employees.)

7. With rubber blankets the repair man guards his body or tools from coming in contact with the third rail. Exhibited by the Pennsylvania Railroad Company at the Safety First Exposition.

8. It is not necessary to go between cars in order to couple them. This is the wrong way. (The Pennsylvania Railroad Company's method of instructing employees.)

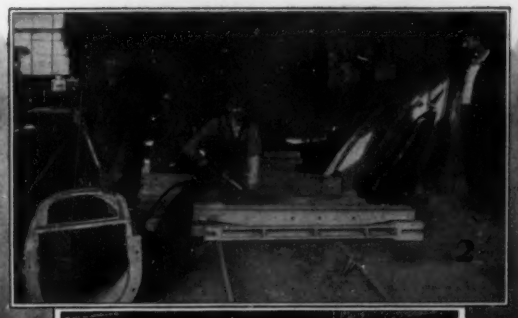
9. This is the right way of coupling cars. Contrast with No. 8. (The Pennsylvania Railroad Company's method of instructing employees.)

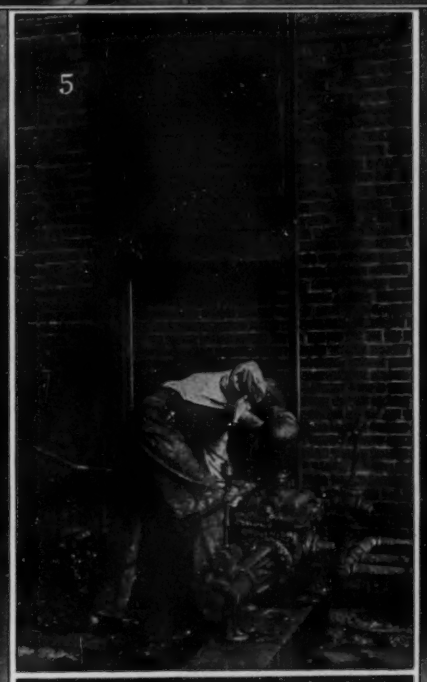
10. The Ferguson double derailing track target, used at the National Tube Company, Lorain works of the United States Steel Corporation. The picture shows the position of derailer when the car is approaching. The device is made double so that it may be fastened to either rail and afford protection from either direction. The word "outside" in cast letters indicates the proper position of derail when attached to rail.

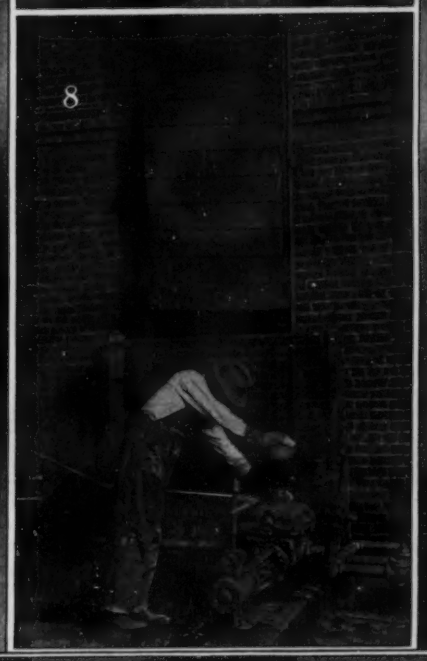
11. This man takes his life in his hands. A slight jar might throw him to the tracks. (The Pennsylvania Railroad Company's method of instructing employees.)

12. Contrast this picture with No. 10. The Ferguson double derailing track target. The front trucks are completely off the rails with derailer still in place.

Safe and unsafe practices in railroading.







1. Gates swinging outward over a footway used by children in going to and from school. (Copyright, 1913, by the United Gas Improvement Company, Philadelphia, Pa.)

2. In the foundry of the New Jersey Zinc Company casting chippers use goggles.

3. The box covering the fire hose is so located that the streams cover the maximum number of buildings and the hose is carefully inclosed, but the real handle projects, so as to render serious injury to a passer-by imminent. The hazard was disposed of by disconnecting and hanging the handle under the box. (Copyright, 1913, by the United Gas Improvement Company, Philadelphia, Pa.)

4. The Benjamin safety device for stamping presses necessitates the removal of both hands from the point of danger, to trip the press before the ram starts in its downward direction.

5. The danger accompanying unlocked elevator counterweights. The valve was so located on the pump that the hand of the workman adjusting it was brought directly under the counterweight and struck. Contrast this picture with No. 8. (Copyright, 1913, by the United Gas Improvement Company, Philadelphia, Pa.)

6. Guard for slotting machine in the Brown & Sharpe works. The swinging guard has a hole so that the workman may see the operating parts and still be protected.

7. Employees entering the building in a hurry formerly took the short cut over the side of the porch and in several instances injured their heads in the manner illustrated. As indicated by the dotted lines, the railing forces the employees to enter at the front of the porch. (Copyright, 1913, by the United Gas Improvement Company, Philadelphia, Pa.)

8. View of the location pictured in No. 8. A wire guard is so placed that there is no danger of a workman's being caught by the counterweight. An excellent illustration of how satisfactory guards may be made at home at very little cost. (Copyright, 1913, United Gas Improvement Company, Philadelphia, Pa.)

9. This picture shows a buzz-saw guard which was invented by one of the employees of the United States Steel Corporation. When the saw is not in use, the guard hangs down and completely covers the blade. When a board is started, the guard rises against the springs *CC* and also turns on the joints *DD* and *EE*. When the board is sawed nearly through, the operator grasps the handle *F* and pushes the board through. His hands do not come near the saw.

10. Lead wires in a passageway back of oil switches. Similar hazards may be found in many offices where connecting cords of electric fans and office machines are left lying on floors. (Copyright, 1913, by the United Gas Improvement Company, Philadelphia, Pa.)

11. This illustration, exhibited at the recent "Safety First" Exposition by the Pennsylvania Railroad, shows the extreme carelessness of an employee seated on a can of gasoline.

12. Safety switch in the foundry of the Brown & Sharpe works. The truck is prevented from running off and falling on the workmen when the switch is open.

How some very common accidents are caused.

Four-Gun Turrets of the French Battleship "Normandie"

A Notable Experiment in the Mounting of Heavy Ordnance

TIME was in the French navy when the authorities favored the placing of only one gun in a turret. Theoretically, so far as the rapidity and accuracy of gun fire are concerned, that was the ideal arrangement. But French naval authorities are distinguished for the great variety and suddenness of the changes which they introduce. To-day the pendulum has swung to the other extreme, and in the four latest dreadnoughts, the "Normandie," "Gascogne," "Languedoc," and "Flandres," the French are putting four guns in a single turret—and this at a time when the two leading naval powers, Great Britain and Germany, are still using only two guns per turret.

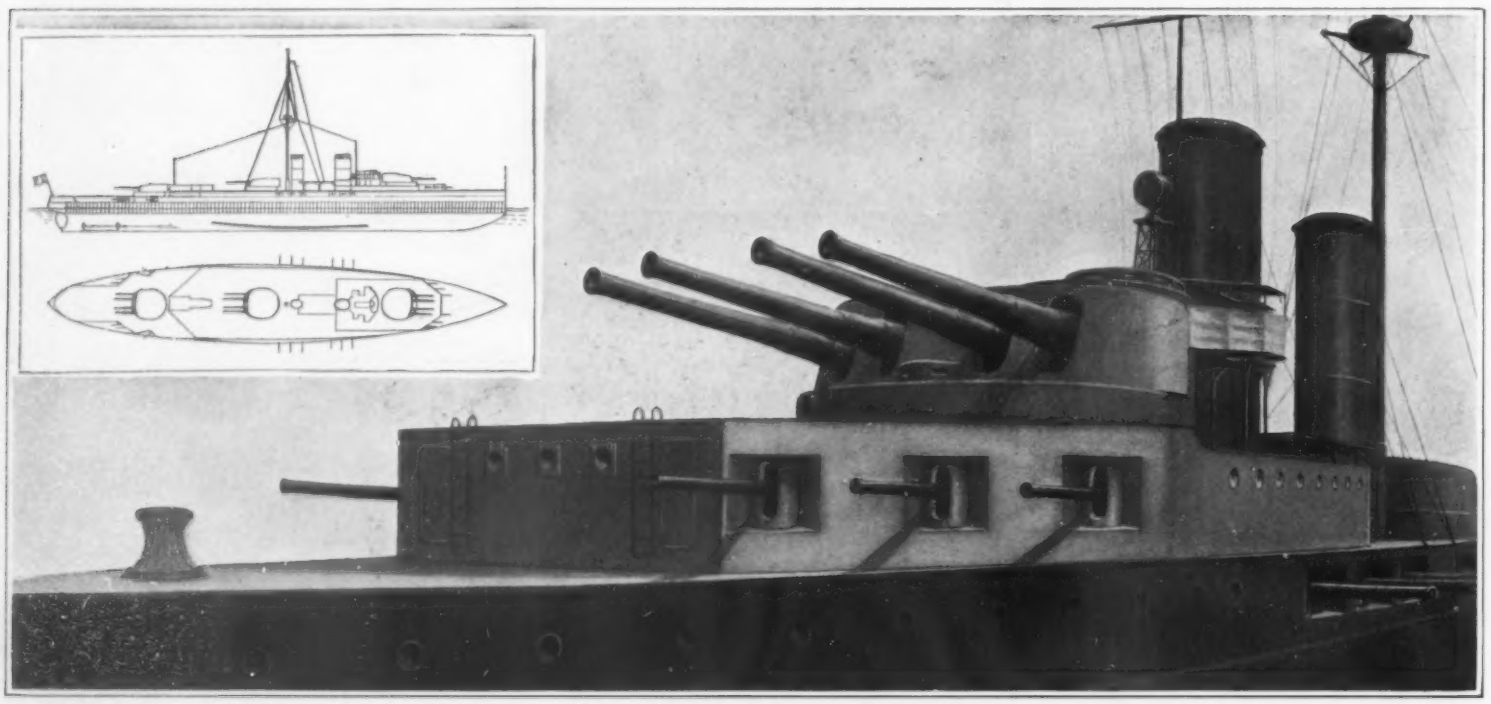
The "Normandie" class are big ships, 574 feet long, 92 feet beam, 28¼ feet maximum draught, and they displace 25,387 tons. The armament is heavy, consisting of twelve 13.4-inch guns carried in three four-gun turrets. The foremost gun is carried above a superstructure on the forecastle deck, the axes of these guns being surely not less than 36 feet above the water line. Amidship above the spar deck is the second turret; and aft above the main deck is turret number 3.

The 13.4-inch gun is a powerful weapon, 45 calibers in length and firing a shell weighing 1,433 pounds, which is slightly heavier than the shell of our 14-inch guns, with a velocity of 2,657 feet, which is slightly greater than that of our 14-inch piece; so that although of less bore, this French gun must be of somewhat greater power than ours.

The advantages of the four-gun turret are that there is considerable saving in weight of armor and gun carriages, and of ammunition lifts and gun-operating mechanism. Also it conduces to good shooting, for the reason that four shots fall in one place, and the work of the spotter is facilitated. It is believed that the guns are not mounted in one sleeve, but in pairs in two sleeves; but possibly the two sleeves are connected to a common elevating mechanism, in which case all the advantages of a single sleeve are secured. The theoretical disadvantage of the four-gun turret is that a single heavy armor-piercing shell, penetrating such a turret, may put four guns out of commission at once.

These ships are heavily armored, carrying about 13 inches on the belt, 17½ inches on the main turret, and 10 inches on the sides of the ship above the main armor belt. The secondary battery of twenty-four 5.5-inch guns is carried as follows: Six in a battery protected by 8¼-inch armor, situated forward of No. 1 main turret, on the forecastle deck, these six guns being capable of fire dead ahead; twelve guns placed in broadside on the main deck between turrets Nos. 1 and 2 and behind 8¼-inch armor; and six guns carried on the gun deck abreast of and on the quarters of No. 3 turret. These positions are shown clearly in our deck plan of the ship.

These four vessels are to be turbine-driven on four shafts at a speed of 21.5 knots. They will be fired with coal and oil. The success of these four-gun turret ships will be watched with great interest in naval circles.



The "Normandie," one of four French ships, of 25,387 tons and 21.5 knots. Armament: Twelve 13.4-inch guns in three turrets, carrying 17½-inch armor; twenty-four 5.5-inch guns, protected by 8¼-inch armor.

The first battleships to carry four guns in one turret.

Fighting Grasshoppers in Uruguay

PEOPLE living in Kansas, Utah, and other parts of our great western plains have by no means forgotten the devastation and desolation caused by the vast hordes of grasshoppers which have swept over the country in former years. Similar pests have visited destruction on the north coast of Africa and on the rich pampas of South America.

Some recent successful efforts at fighting this plague are described in *Kosmos* by L. Geret of Antwerp as follows:

"As soon as the little creatures hatched from the eggs deposited in the earth by previous swarms are able to hop, and even before they can fly they exhibit the migrating impulse. The habitat of this Argentine plague is in the north, near the Bolivian boundary; from there the swarms overflow the rich provinces of Santa Fé, Entre Rios, and the Republic of Uruguay. In dry weather the insects lay their eggs *en route*, and pursue their career of destruction to a point south of Buenos Ayres, soon after which they expire. By January the swarm issuing from the eggs has reached maturity. . . . When at a given time all the "hoppers" of a locality set themselves in motion toward the same direction is the moment chosen for fighting them by the ancient method of the country. Sheets of tin are bound together so as to stretch continuously for many kilometers, forming barriers whose smooth sides it is impossible for the insects to scale.

"Every tree near this tin barrier is likewise provided with a tin 'cuff' to prevent its being used as a bridge. The current is checked at the barrier and begins to flow along its side. Near the barrier at spaced distances deep holes are dug and surrounded by tin barriers placed at such an angle as to form a diminishing passageway or conduit to the mouth of the hole, into which the stream of insects flows steadily till it is full. As each hole is filled it is covered with earth and stamped down and fresh holes are made.

"Naturally only a small proportion of the insects can be destroyed by this simple means. The others increase in size—many reach a length of 8 centimeters and rise into the air like a dark cloud and fly away to seek food. One evening, at Fray Bentano's on the Uruguay the writer helped frighten away a swarm which had even from afar the threatening aspect of the smoke from a conflagration, had then flown over the river, 7 kilometers wide at this place, and was about to settle on the beautiful flower-decked gardens of the casino of the Liebig Company. With hastily concocted banners, with whistles, trumpets, bells, tin-pans, flint-locks, a deafening gong, and an untiring gramophone, the great body of the hungry swarm was driven away to fall on more distant fields. Yet enough of them remained with us to rob many a tree of its crown of leaves, and the procession of the flying insects seemed almost interminable, offering a noteworthy spectacle. . . . The extent of such swarms in flight has been estimated to be at times dozens of kilometers in length and many kilometers in breadth.

"An indefatigable investigator of the Pasteur Institute in Paris, Felix d'Herelle, has succeeded by the artificial propagation of an insect-cholera in almost annihilating the most formidable swarms of this pest in the Argentine. During a stay on the Yucatan Peninsula in 1910 this well-known bacteriologist studied a malady then raging among the grasshoppers there. Dr. Roux, the director of the Pasteur Institute, presented the results of his observations before the French Académie des Sciences.

"According to this report a certain bacillus (*the coccobacillus acridiarum sp. nov.*) has such an effect on the grasshoppers that they perish within 12 to 36 hours. The intestinal content of the insects is then found to be an almost pure culture of the bacillus. M. d'Herelle expressed the opinion that the insects could be exterminated by any artificial spread of this '*epizootic*.'

M. Gallardo, the director of the National Museum of Buenos Ayres, was staying in Paris at the time, and induced the Argentine Bureau of Agriculture to invite the French investigator to test his process practically in South America. M. d'Herelle accordingly caused a swarm of grasshoppers in Santa Fé to be surrounded by a palisade in order to study the effects of his epizootic cultures within the inclosed space.

"These culture of bacilli were dissolved in water and sprinkled over a small portion of the maize which the insects had begun to devour. The malady spread with extraordinary rapidity. By the end of two days dead grasshoppers were found in every corner of the field of experiment; after the sixth day there were none left alive.

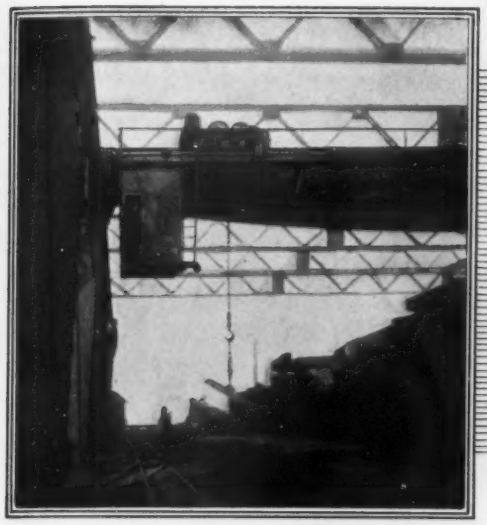
"Experiments on a large scale were attended by a like success. One liter of the culture liquid was spread over a field. After 5 days countless dead insects were found over the whole extent of the field of 35 hectares. The fatality continued on following days and spread through the vicinity. The speed with which the malady spreads is amazing. Only a few days after the start of the infection it was found to have extended to 50 kilometers distance from the original spot, being in every case carried by the winged insects, which are capable of covering 30 kilometers in a day.

"Other varieties of grasshoppers were also attacked by the disease, so that the hope is justified that it will prove an effective agent against this fearful plague in other localities."

Safety in Steel Works

The Scientific American's Associate Editor Sees How Employees Learn Caution by Hunting Dangers

By A. Russell Bond



The crane man used to have to climb up the lattice work to his cab.

Railed stairways and platforms with safety treads now lead to the crane cab.

The first attempt at safety for the crane man was a wooden ladder.

ANYONE who thinks that the safety movement of which we hear so much these days consists merely in an agitation for the adoption of safeguards and "fool-proof" machinery, is far behind the times. Probably that individual also thinks that the "fool" against whom the machine must be "proofed" is an ignorant foreigner. But that is another mistaken notion. The man who gets hurt is the careless man. He may be careless by nature or by design, and to neither of these classes does the foreigner belong. The very newness and strangeness of his surroundings makes him cautious. The man who makes the most trouble, not only for himself, but for his fellow workmen, is the one who thinks it smart to take a chance, the one for instance who does not consider himself or his fellow a good railway man unless he can stand between the rails before an approaching locomotive and step upon the footboard just as he is about to be struck. He is a good sport and takes a chance on what he feels is a pretty sure thing. Nevertheless, it is a game of chance and stakes are very high.

A man of such disposition is most ingenious in devising methods of self destruction or injury, and the mere provision of safeguards cannot cope with his propensity to mischief. Something must be done with the man as well as with the machine, and so now the more progressive safety organizations lay great stress on educating the careless employee to a new attitude toward the dangers that inevitably lurk about him. The best way to learn a thing is to teach it. Hence, it is the custom to make safety instructors of the men themselves, as in that way they will learn what the safety movement is, and how best it may be furthered.

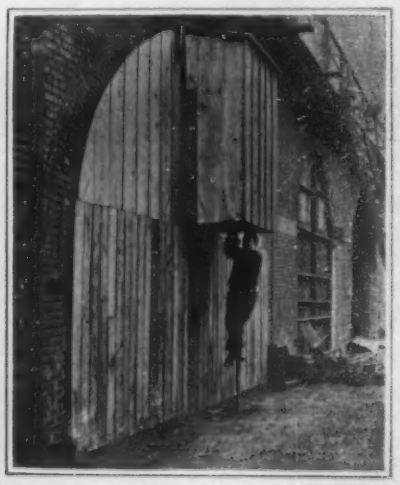
An excellent illustration of this method may be found in the organization of the United States Steel Corporation. The safety idea permeates the whole organization from the highest official down to the workingmen themselves. First of all there is the Steel Corporation Safety Committee, consisting of an officer of the Steel Corporation as chairman and seven other members representing the largest subsidiary companies. This committee meets quarterly to study serious accidents and makes recommendations against further occurrences. It conducts its inspection by having an inspector of one company inspect the other company's operations. All the inspections are made personally. Second, there are central safety committees of the subsidiary companies, made up of important officials from each of the plants, mines or railroad divisions, which conduct intermill inspections and meet monthly for conference and recommendation of safety devices. Third, there are plant safety committees which meet monthly, weekly, or in some cases daily. Fourth, there are the department and special committees, made up of foremen, master mechanics and skilled workmen, who meet weekly or monthly as the case may be. And finally, there are the workmen's safety committees, usually made up of three members of the rank and file of the mill. These members are changed periodically, so that eventually every man in the works will at one time or another have held a position on one of these committees.

During the year ending December, 1912, 4,678 men served on the various committees, and probably the greatest service was done by the last two committees, because they were made up of those men who were studying their own personal risks, trying to find trouble before trouble found them. It is the policy of the company to encourage the men to make suggestions by means of rewards. As an illustration of the value that is attached to the employees' own recommendations, we may take the case of the guards placed over circular saws. When the foreman of the shop is informed that he must place a guard over the saw and a certain standard type of guard is recommended to him, he is quite apt to look with contempt upon the device and criticise it as being of little value. "All right, John," says the safety inspector, "you are an ingenious fellow. Why don't you get up a safety device that is really safe?" And so John thinks the matter over, and in a day or two suggests a design for a new guard which the safety inspector praises highly and is glad to accept; for although the device may not be as good as the one originally recommended, it will be scrupulously used, and the foreman will see that all the men under him use it too. Far better is a poor device faithfully used, than a good device employed under protest. But the result of this policy of letting a man build his own safety device has resulted in the designing of some very clever apparatus. With the ordinary guard there is nothing to prevent the operator from having his thumb cut off as he follows up the work to the saw. One ingenious foreman, realizing this defect, provided the bottom of the saw guard with teeth or notches, by which the work could be pushed up to the saw. This safety device is illustrated on another page.

The writer recently had occasion to visit the works of the Illinois Steel Company at South Chicago, and was struck by the "safety first" atmosphere that pervaded the whole works. Safety signs in five languages were set up at all points in the works where there was a possibility of accident. Not only that, but the men themselves seemed imbued with the safety spirit and enthusiastic in their support of safety methods. Last spring an accident occurred in one of the open hearth buildings, which illustrated not only the efficiency of the safety precautions provided against such an accident, but also the spirit of the men. A huge ladle containing fifty tons of molten metal was being taken down the building by means of a traveling crane. One of the bearing boxes of the winding drum of the crane broke, causing the drum shaft to tilt and throw the gears out of mesh. Immediately the tackle on one side of the ladle slacked away, permitting the molten steel to pour out upon the floor below. A spill of this sort

A steel closet provides shelter for the crane man should there be an explosion due to a spill of metal.

Covering a planer bed and oil holes saves operator from being caught by the advancing table. Open planer beds were used for storage and operators were frequently hurt by the advancing table.



Firemen's poles provide a quick escape from the open hearth building in case of an accident.

is invariably attended by an explosion, and not a second must be lost in jumping out of the way to avoid being burned to death. To provide for just such an emergency, the outer wall of the building had been provided with window openings all along the pouring level, and these windows were protected on the outside by means of wooden hoods. Four or five men were on the pouring platform when the accident occurred, and immediately they leaped to safety through the opening. (See our cover illustration.) The crane man also was in immediate danger and had to act instantly. There was not even time to stop the crane. He leaped for a ledge above the craneway and dodged through one of the many windows provided for just this purpose, to a runway at the outside of the building. It was a narrow escape; but the crane was still running down the mill, pouring out a stream of liquid fire, and if it were not stopped, would soon reach a number of men who were at work in the "pit" with no chance of escape; also if the crane continued, it would eventually strike the end wall of the building and doubtless go to smash or destroy the wall. Mindful of these dangers despite his own harrowing experience, the crane man ran along the runway outside of the building until the first flare of the explosion had subsided. Then he dodged through one of the windows ahead of the crane, jumped into the cab as it came along, and brought it to a stop. His presence of mind saved many lives and valuable property. He was rewarded by a "safety first" banquet and a raise of pay. Although the men who were on the pouring platform did not hesitate an instant to take the leap, nevertheless after they had undergone the experience, they realized that a jump into space required some courage and was not without danger. Accordingly, one of them recommended that the openings be provided with firemen's poles, down which the men could slide. This recommendation was immediately adopted, and one of the accompanying photographs shows how the hooded openings now look with the pole equipment.

So sudden is the explosion from a tipped ladle, that sometimes the crane man has no opportunity to dodge out of the building. Accordingly the cabs are provided with steel compartments in which the operator of the crane may shut himself for protection against the intense heat. This gives him a chance of escape unless the heat is so prolonged as to bake him inside of his shelter.

Ladles are usually tapped by withdrawing a stopper. Formerly the stoppers were suspended by an ordinary crane hook, but on a couple of occasions as the stopper was being lowered it struck on the rim of the ladle, and as it hesitated there an instant, the slack in the hoist cable allowed it to become unhooked. One of the employees suggested a "pig's tail" hook, which has proved entirely satisfactory, as it prevents the suspended load from going over the point of the hook. Another type of safety hook designed by one of the men has a handle at the back by which it may be operated without danger of catching the fingers between the hook and the load.

Hundreds of little devices of this sort have been developed by the workmen's safety committees. One of the illustrations shows an improved mud gun, developed at the works of the National Tube Company in Lorain, Ohio. It is a machine with which balls of clay are packed into the tapping hole of the furnace to close it after the furnace has been tapped. The clay balls are dropped through a hole in the casing of the gun in front of a plunger which drives them into the opening. It used to be that if a clay ball jammed in the hole, the operator would push it down with his foot. As a result many a heel or toe was cut off by the plunger because the man pushed his foot in too far. To overcome this, a funnel is placed on the mouth of the mud gun, making it impossible for a man to push his foot in far enough to get it caught.

While the workmen supply many safety suggestions, most of them come from the official safety inspectors. Herewith is a set of three pictures from the Carnegie Steel Company's plant at Homestead, Pa., illustrating the improvements that have been developed in providing access to the crane cab. Originally the operator of the crane was obliged to climb the steel lattice work of the columns in order to reach his cab. This proved a dangerous practice and so ladders were provided, as shown in another picture. But this still required a man to be pretty much of a monkey in order to reach his cab, and eventually, steel stairways and platforms with friction treads were provided, so that a man could reach his crane cab in perfect safety. The platforms also are of use in making repairs upon the crane.

In a plant like that at Gary, Indiana, which has been built since the safety movement was started, safety provisions were made from the very start. But in the older plants an enormous outlay was found necessary to bring them up to present day safety standards. One of our illustrations shows a trolley for window cleaners

(Concluded on page 130.)

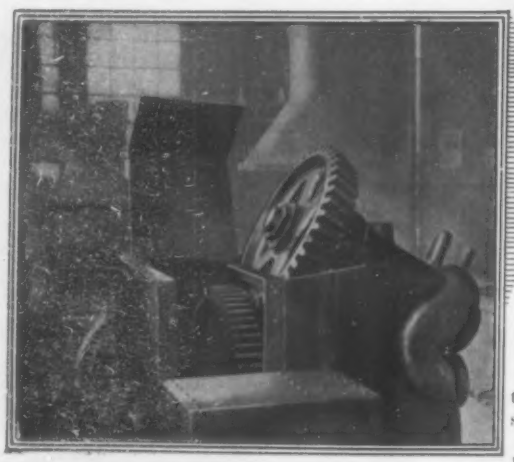
A funnel on the mouth of the "mud gun" prevents chopping off of toes and heels.

The windows of the saw-tooth roof are safely cleaned from the trolley that runs all around the building.

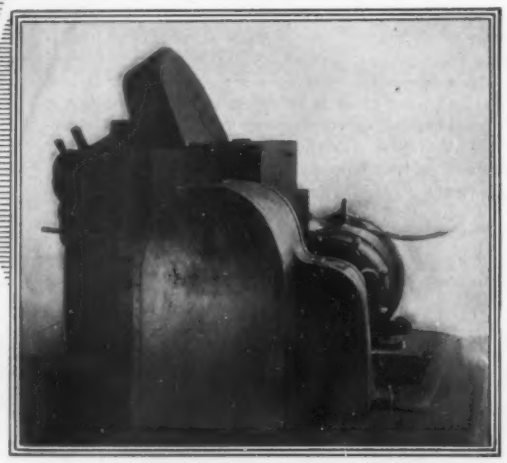
A handle on the hook saves the fingers.

Castings are broken up with a skull cracker picked up by an electromagnet and dropped upon them. To stop flying fragments a stockade of pipes filled with concrete has been set up. The value of this stockade is shown by the dents in the pipes.

This hook will not release when cable is slack.



These gears used to be uncovered and were a constant menace.



Now the bevel gear is almost completely inclosed in a sheet steel casing.

Let the Sun Supply Hot Water

THE sun will keep your hot water boiler full with the aid of an inexpensive device, a solar heater on the roof, that not only supplies water at a high temperature on warm days, but also, by means of a cleverly devised tank, will conserve the heat over a couple of dark days. This is made possible by a packing around the tank similar to that in a fireless cooker. Not only hundreds of homes in the West are thus equipped, but a number of public buildings, notably playground and school buildings, in California make use of this system to supply hot water for shower baths without cost. After the plant is paid for, there are no further charges. The photograph shows one of the largest of these public installations, a 500-gallon tank heated by three night-and-day solar heaters on the roof of the playground building in Exposition Park, Los Angeles. The "chimney" on this structure is in reality a screen for the tank, which is set upright in the attic, projecting through the roof. The heating coils of galvanized iron pipe are in the three glass-covered boxes, exposed on the southern face of the roof. These are connected with the tank, which in turn connects with the showers. No artificial heat is needed. For use in the Eastern States, the system is available the greater part of the year, while in winter the heater coils are drained to prevent freezing, and an auxiliary piping system that joins the furnace or other house-heating device is installed. Half a dozen playgrounds and four or five schools in California have been thus equipped recently, while the domestic installations have been in successful use for years. Even apartment houses have made use of this economical method of obtaining plenty of hot water at any hour of the day or night.

The Highest Dam in the World

THE United States Reclamation Service is blocking the Boise River canyon, at Arrowrock, with a dam 350 feet high. This will be the highest dam in the world. It will have a length of 1,075 feet at the top, and will contain 530,000 cubic yards of material. During construction the waters are being diverted through a tunnel running around the dam. The tunnel is 487 feet long and measures 25 by 30 feet. It is large enough to pass the whole of the Boise River. The accompanying photograph shows the water pouring out of the tunnel. On the right, near the top of the picture may be seen the excavation for the spillway, which shows to what a height the dam will be carried.

German Gasoline-Electric Road Train

By Our Berlin Correspondent

A REMARKABLE gasoline-electric road train has recently been introduced in Germany which comprises a power car and ten trailers each of 5 tons capacity.

The power car carries the generator set, viz., two Daimler motors of 125 horse-power each, driving a dynamo installed in the center. The current is transmitted to the electric motors actuating each of the wheels of the power car and trailers. The armatures of these motors are arranged in parallel, and the inductors in series; the former derive their current from the main dynamo, whereas the latter are fed from an exciter machine which at the same time serves to excite the main dynamo. The field regulator of the main dynamo controls the tension of the armature, and accordingly, the speed of the train. A loop circuit allows a perfect uniformity of tension to be insured in all motor armatures. The motor fields are excited by a special "traction regulator," inserted into the exciter circuit, and the direction of travel is controlled by reversing the excitation of the motor fields.

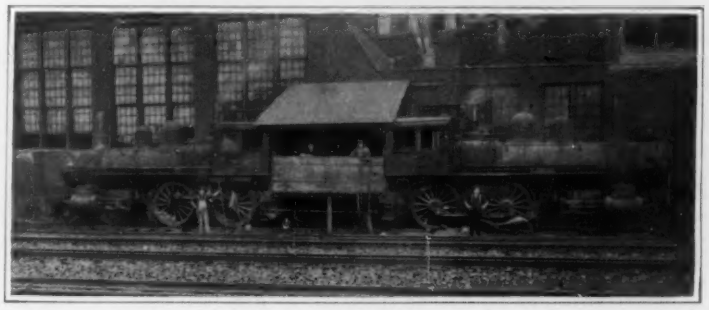
The electric apparatus and instruments are arranged on the motor car, above the dynamo, so as to be readily accessible.

The steel rims of the wheels are 1.2 millimeters in diameter and 250 millimeters in width. Thanks to the identical construction of all the trucks, the number of exchange parts is reduced to a minimum. Chain transmission has been used to connect the trucks with one another, and the inside brakes formerly used have been replaced by outside brake shoes acting directly on the circumference of the wheels, thus greatly facilitating the superintendence of the brakes.

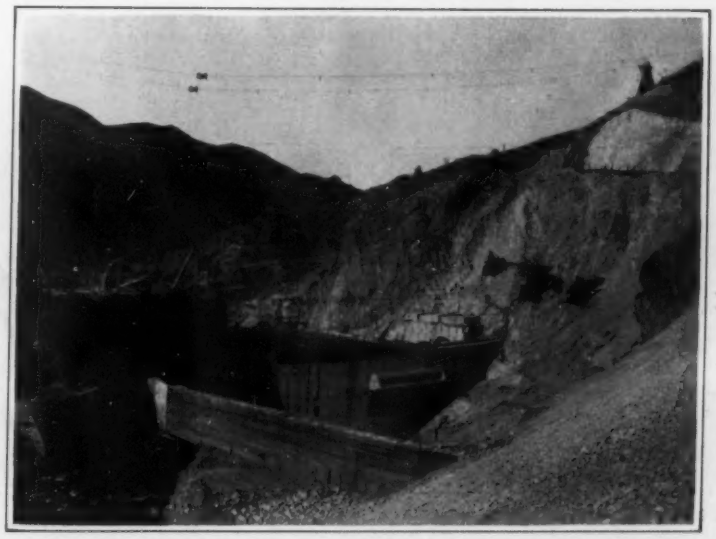
The weight of the power car in full working order is 9 tons, and of each trailer, 3 tons, or 39 tons altogether. The ratio between the carrying capacity and the net weight thus works out at 50 ÷ 39 = 1.3, which is 30 per cent more favorable than in the case of heavy load vans. The mean traveling speed is 12 kilometers (7.5 miles), and the maximum speed 16 kilometers (10 miles) per hour.

Solar heater on the playground building in Los Angeles furnishing hot water for shower baths.

Ostrich trotting team. Note the third wheel.



Two locomotives supplying a factory with steam while the boiler plant is being repaired.



Building the Arrowrock dam across the Boise River; the highest dam in the world.

Gasoline-electric road train of 50-ton capacity.

How the Ostrich Rancher Travels

THE rancher in California or Arizona who goes into the business of raising ostriches can travel behind a team of these huge birds or use one as a saddle animal. The ostrich shows remarkable speed as a trotter, and a pair of them attached to a light sulky can make a mile in pretty close to two minutes. It will be observed that the light rig is equipped with a third wheel to take part of the weight from the team. The ostrich as a mount is almost as speedy, and carries a man easily.

A Unique Emergency Power Plant

WHEN a manufacturing plant is confronted with the problem of replacing an old, inadequate battery of boilers with a new one of greater capacity, it is not a simple matter to make the change without interrupting operation.

This condition was met most ingeniously when it became necessary for a company of Philadelphia, Pa., making textile machinery and centrifugal hydro-extractors, to increase its source of power supply. An estimate from the local company showed electric power to be of prohibitive cost. The idea of utilizing locomotives for the purpose, while novel, at first thought, bore the elements of sound judgment.

The location of the plant, on the main line of the Pennsylvania Railroad, made feasible the storage of locomotives on a long freight siding.

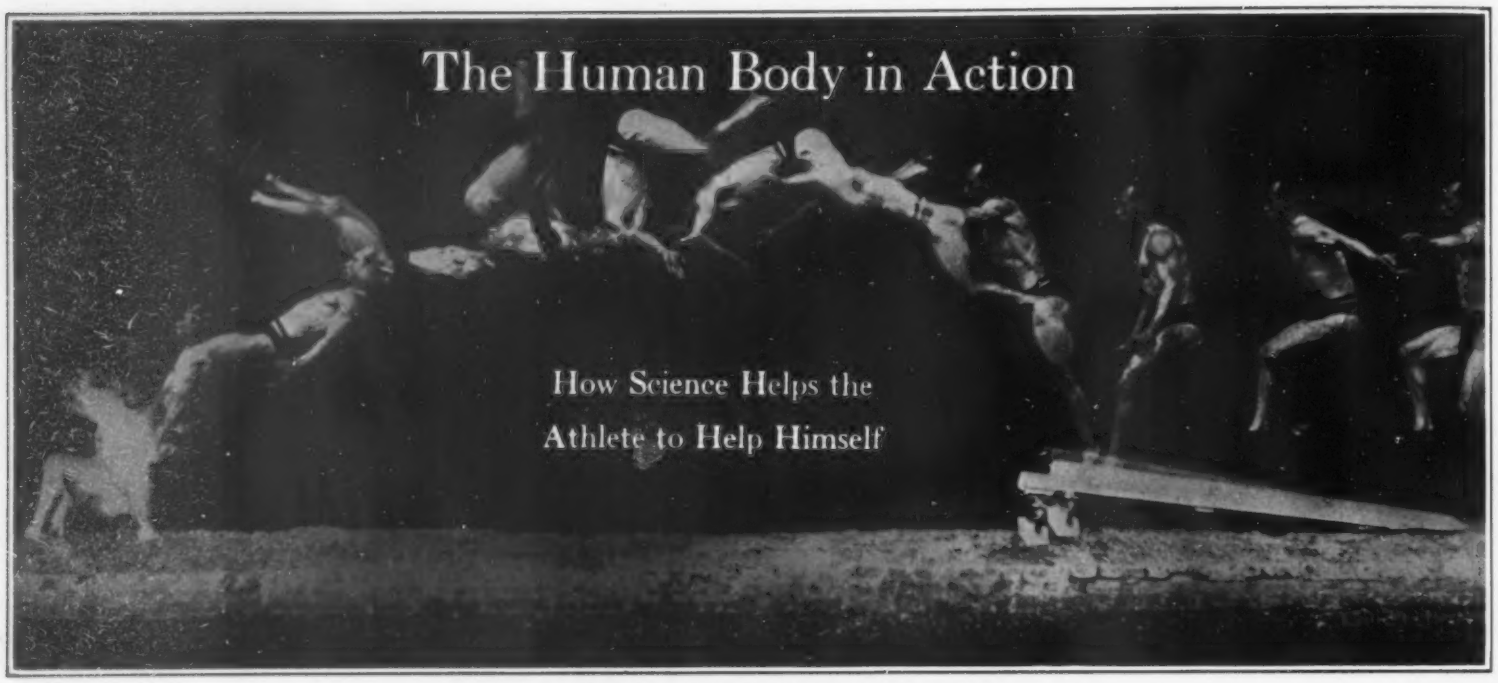
It remained a problem, however, to get locomotives of the proper capacity, for in these days of heavy railroading, small engines are rather difficult to obtain.

Two "American" type locomotives were finally obtained at a very reasonable rental. While they were doing service, the old battery of two boilers was replaced with a 462 horse-power boiler, stoker-fired by an automatic stoker of the five-retort type; the furnace is fitted with an extension grate, giving enough grate area to insure absolute combustion of the fuel, without having to have a brick arch.

The process of locomotive boiler substitution was simple, but effective. The two old locomotives, whose connecting rods and valve gears had long been disconnected, were hauled to a convenient point on the siding, after their tenders had been uncoupled; their throttle valves were closed, and a connection piped from their auxiliary domes, over the fireboxes, to the main steam lines in the plant.

Their positions, back to back, with an elevated platform erected between them, allowed sufficient space for two firemen, and a coal supply that could be replenished without interrupting the service.

As a matter of fact, this means of steam supply is hardly economical enough to warrant its retention for a protracted period, since the amount of coal consumed per horse-power hour is far greater than the average manufacturing plant can afford; but there is no question that the money for the excessive coal consumption, in addition to the moderate rental, and a few dollars more for labor, are well spent when a continuous, liberal steam supply is assured, that keeps the plant in operation during the installation of the new boilers, and whose connection with the main steam supply can be made in a short time at night, without stopping operations.



The phases of a springboard acrobatic somersault.

EVER since 1896, the year in which the historic Olympic games were reinaugurated on a scale far grander than that conceived by the ancient Greeks themselves, there has been an unquestioned increase not only in the popular interest in athletics, but in scientific interest as well. In France physicists have applied scientific methods to the study of athletes in action with astonishing results. To be sure, this is nothing new. Years ago Muybridge published a series of photographs taken of men and animals in action, which are still regarded as classic in their way. But since Muybridge's day, apparatus and methods have improved, and it is now possible to record for future study athletic movements which it would have been difficult indeed to analyze twenty years ago.

Probably the foremost of Muybridge's successors is the distinguished Prof. Marey, whose interesting and valuable work has been so frequently commented upon in the columns of the SCIENTIFIC AMERICAN. The accompanying pictures were made in accordance with his methods by Prof. Demeny. The apparatus used has been improved by Demeny and used by him at the French Academy for Military Sports in Joinville-le-Pont.

As our pictures show, the athletes are photographed, not upon a moving picture film a thousand or more feet in length, but upon a single plate. A black background is employed and the subjects are brightly illuminated, with the result that they are very sharply defined. The movements can be analyzed into as many separate stages as may be desired, so that the result is not unlike a very slowly moving cinematographic film. Because the pictures are all taken upon a single plate, they lend themselves admirably for study and instruction. It is perfectly apparent that from pictures such as those which we publish, the athlete can learn much. He sees at once at what particular point of a movement he assumed an incorrect position, and why it is that he runs, walks, leaps, or fences inefficiently. Hence, photographs such as those which we reproduce have a very practical value. At the Joinville school, they are used to record and register the physical conformation and development of the pupils before, during and after training. The studies thus obtained are applied in choosing and instructing the gymnastic staff of the French army.

Any one of the pictures made in accordance with the Marey-Demeny system constitutes what may be called a "graph" or chart. It ought to be possible for an athlete to compare his photographic self, reproduced perhaps a dozen times on a single plate, with a standard "graph," and thus determine how he compares with a crack runner, fencer, or gymnast. "What am I doing wrong?" is a question that every athlete puts to himself. Even his trainer cannot always answer that question correctly; the movements are so very numerous and so very rapid that only the general effect produced can be criticised. In some games, such as in football or tennis or fencing, the timing of each movement is of vital importance. By studying photographs of himself, the player or fencer will learn, first, what is the minimum number of movements required and then the trick of making them in the minimum time.

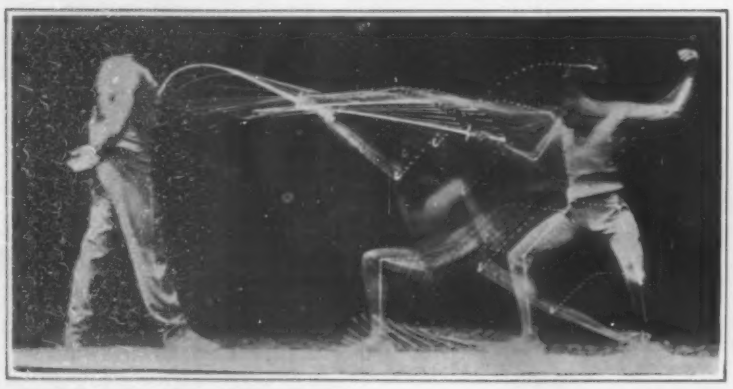
It is obvious that the moving picture camera will accomplish much the same result as the apparatus of Professors Marey and Demeny. But on the other hand, a moving picture machine and its films are expensive. Besides, it is not easy to run a film slowly enough to enable an athlete to analyze his movements, because the highly inflammable celluloid of the film may catch fire if it is held too long before the electric arc.

Military Aeronautics in the United States

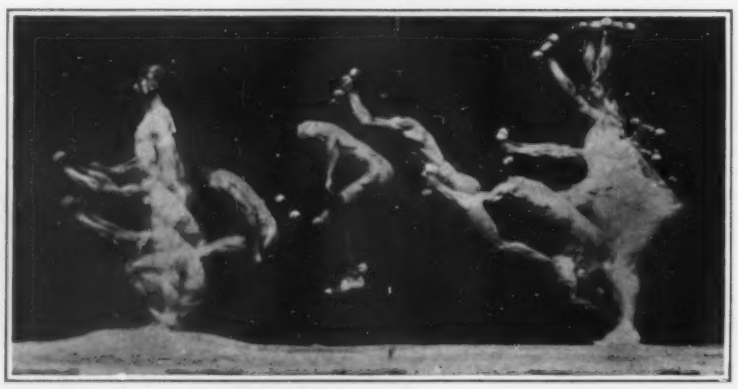
MILITARY aeronautics is extensively discussed in the report of the Chief Signal Officer, United States Army, for 1913, just published. This report emphasizes a fact of which the public is probably not generally aware, viz., that the number of civilian aviators in this country is fast diminishing, and in the event of war at the present time it is doubtful whether a score of men capable of making flights useful to the army could be obtained from civil life. Hence, the urgent necessity of increasing the aeronautical branches of the army, navy, and national guard. The Signal Corps at present

A pole vault in all its more interesting stages.

A hurdler in action.

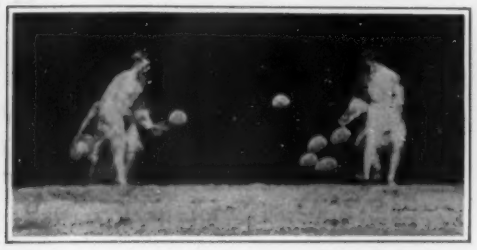


The displacement of a fencer's body and arm during action, showing how a graph can be obtained.



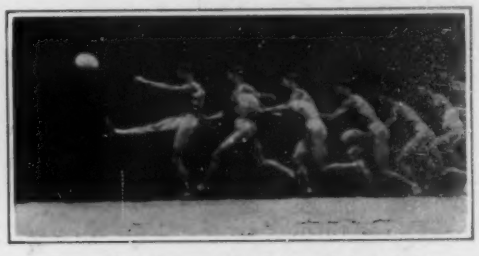
A standing broad jump made with the aid of dumb bells, showing how weights aid the athlete.

possesses only a handful of aviators and twenty-three aeroplanes. In 1913 the United States Government appropriated $125,000 for aviation, while France appropriated $7,400,000, Germany and Russia each $5,000,000, England, $3,000,000, etc. Since November, 1912, aeroplanes have been used successfully in the United States Army for observing and directing field artillery fire. When an aeroplane ascends a couple of thousand feet it is possible to see the reverse sides of hills and locate targets thereon that could be found in no other way. The aviator then signals to the gunners; preferably by wireless telegraphy, though the methods of dropping cards and using smoke signals have been tried with some success. The radio sets for aeroplanes devised in the Signal Corps laboratory weigh about 75 pounds and are believed to be capable of sending thirty miles. No receiving apparatus has yet been devised, but this is comparatively unimportant, as the prime requisite is to send from the aeroplane the results of the aviator's observations. Aeroplanes were used for scouting during the Connecticut maneuvers. Troops were located very easily and accurately by all the aeroplanes and their positions plotted on a map. Photography, map-making and bomb-dropping have all been tried by our military aviators with encouraging results. The Chief Signal Officer urges at length the claims of the dirigible balloon, heretofore almost completely neglected by our Army, and recommends a further increase in the pay of officers and men attached to the aeronautical branch of the service.

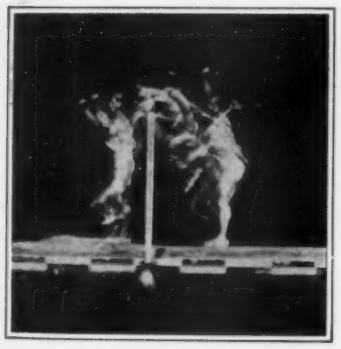


The player on the right has fumbled the ball.

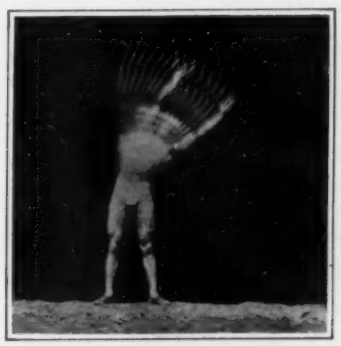
Composite photograph of a bad kick-off.



Composite photograph of a good drop-kick.



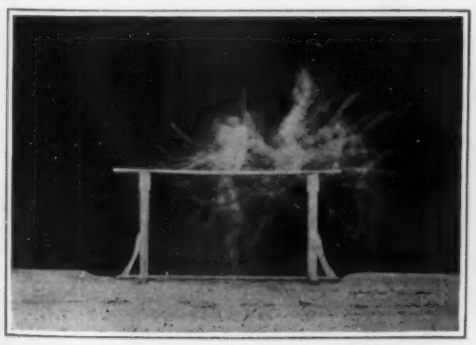
Study of a standing high jump from start to alighting.



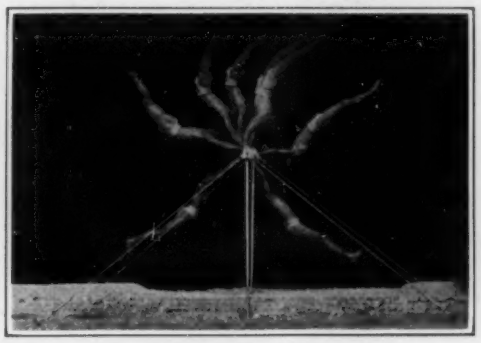
Composite photograph of a familiar calisthenic exercise.

Study of an exercise for developing the abdominal muscles.

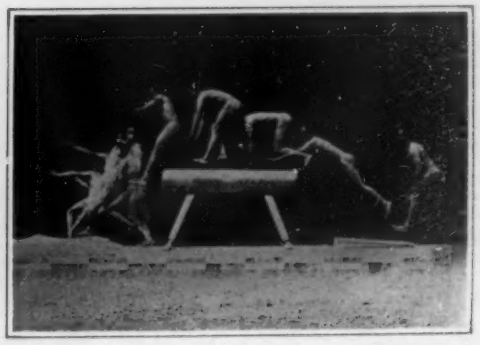
How an athlete jumps from a height to the ground.



Swinging between the parallel bars.



Seven stages of the giant swing.



Leaping over a gymnasium horse.

Spontaneous Combustion

THE term "spontaneous combustion" is generally connected in the public mind with coal, green hay or charcoal, but its application is much more extensive. One rather rare catastrophe often ascribed to this cause is the mysterious explosion of a flour mill. In reality this is due to the accidental spark ignition of an intimate mixture of flour dust and air. The mixture must be just right, yet once in a long time the dust-laden air of a mill meets the requirements and is ready for a spark from the machinery to start the trouble. Oxidation of dust in the region of the spark spreads almost instantaneously, and an explosion results.

Suspended coal dust in air can be exploded with terrific force as was shown by the recent Pittsburgh experiments of the Bureau of Mines.

Chemists work with many substances that spontaneously ignite when exposed to the air—or oxygen—and the accompanying difficulties are annoying. Zinc ethyl is an example and another even more spectacular is "pyrophoric iron"—pure iron dust prepared by the reduction of iron oxalate in an atmosphere of hydrogen. This curious variety of iron is sealed in the glass tube in which it is prepared—free from air—and when the tube is broken the instant combination of the iron and oxygen is accompanied by a flash of flame.

Of vastly greater concern to the public is the spontaneous combustion of coal. In large masses coal slowly unites with oxygen, producing some heat, and if this heat is not rapidly conducted away it acts as an accelerator to further oxidation. Since raising the temperature 18 deg. Fahr. doubles the velocity of most chemical reactions one can appreciate the cumulative effects of oxidation in large masses. In a small pile of coal this heat is slowly developed and radiated so readily that no rise in temperature is noticed. In a large pile of densely packed coal, however, radiation is restricted so that the temperature rises and, under favorable conditions, reaches the ignition point.

Coal dust exposes more surface than the same weight in lumps, so it is a source of danger, especially when mixed with lumps in such a way that air passages extend into the interior of the mass. When this circulation of air in the pile is just sufficient to support the oxidation, but not enough to carry away the heat developed, spontaneous combustion results. The Bureau of Mines sent out 2,000 letters of inquiry to large coal consumers of the United States, and out of 1,200 replies, 260 reported cases of spontaneous combustion. A great many such fires have occurred in the large storage piles at Panama. These are mostly Pocahontas, which produces an abnormal amount of dust.

The Bureau of Mines makes the following recommendations:

1. Do not pile bituminous coal so that any point in the interior will be more than ten feet from an air-cooled surface.
2. If possible, store only lump.
3. Keep dust out as much as possible, therefore, reduce handling to a minimum.
4. Pile so that lump and fine are distributed as evenly as possible; not, as is often done, allowing lumps to roll down from a peak and form air passages at the bottom.
5. Rehandle and screen after two months. Even if considerable heating has taken place this handling will cool it off and combustion seldom takes place afterward.
6. Keep away external sources of heat even though moderate in degree.
7. Allow six weeks seasoning after mining before storing. This allows the surface of the lumps to become less liable to oxidation.
8. Avoid alternate wetting and drying. Eastern coals may be stored under water in safety without loss. Western coals take up too much water under such treatment and much heat is lost in steaming out this absorbed water.
9. Avoid admission of air to interior of pile through interstices around foreign objects such as timbers or irregular brick work; also through porous bottoms such as cinders.
10. Do not try to ventilate by pipes as more harm is often done than good.

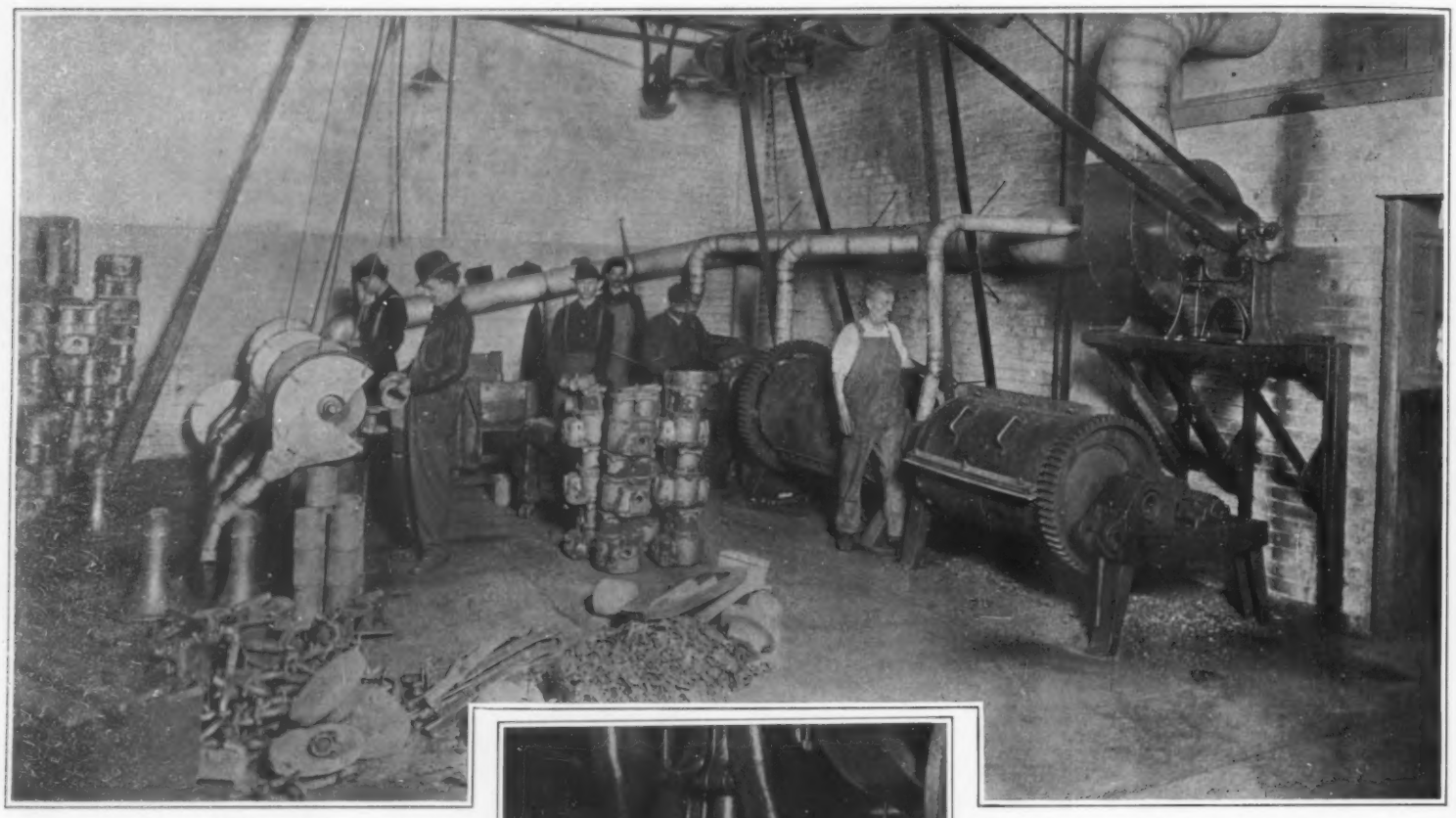
Charcoal, because of its great porosity, is peculiarly liable to spontaneous combustion. Its use as a deodorizer depends on its wonderful power of absorbing gases and experiments have shown that after exposing to a white heat for three hours charcoal can still retain a small amount of absorbed gas. Its enormous inner surface for contact with oxygen is often its own destruction. Charcoals made from some woods ignite as soon as exposed to the air. In 1911 there were sixty-four reported fires in the transportation of charcoal in this country alone, and of these all but one were apparently due to spontaneous combustion.

A farmer's barn stored with green hay is always in some danger. Unless the juices were properly sun-dried considerable fermentation takes place in the mow and the heat generated facilitates oxidation. The mass of hay is often so great that in the interior heat is developed faster than it is conducted away and then the ignition point is approached and possibly reached.

What About the Wheels?—It is interesting to note that in nine cases out of the proverbial ten, the wheels—most vulnerable parts of all—of armored automobiles are left practically unprotected. One well-directed shot might very easily so cripple the average armored car as to place it completely at the mercy of anyone with real or fancied reason to accomplish its downfall. The necessity for properly armoring wheels as well as bodies is very real and very earnest and cannot well be overlooked.

Safety in an Automobile Factory

Methods That Have Produced a Sixty Per Cent Reduction in Accidents



Forced draft apparatus for drawing steel particles from the grinding room.

The hammer cannot drop until the workman has removed his hands from under the safety cross bar.

"SHOW me the conditions for an accident," says a prominent safety official, "and I will show you the accident." He is associated with the United States Steel Corporation, which employs so many men that almost every kind of an accident that might occur has occurred at one time or another in its history. When a possible source of danger is pointed out to the foreman of a shop, he is quite apt to laugh at the idea of any risk. "Why," he will exclaim, "we have worked here twenty years without an accident." To this the safety inspector can almost invariably reply that such an accident did once happen in such and such of their own plants, and there is no reason why it should not occur here at almost any time. The need of safety precaution is more apparent in a large corporation employing hundreds of thousands than in factories employing but a few hundred. Yet it is no less real in the latter than in any one of the plants of similar size in the big corporations. If safety precautions pay in one, they should pay in the other.

We love to dwell on the more noble, humanitarian side of the safety movement. But it is not merely a question of philanthropy; it pays in dollars and cents. Employers must not forget that it costs something to break a new man into the work. Every workingman is an asset to the company, and if he be incapacitated by accident, the employer must figure among other losses that of the money invested in this man's training; for in order to replace him, he must go through all the trouble and expense of breaking in a new man. This is so in almost any line of work, but particularly in those factories where the work is of a highly specialized character.

This high-speed machine may be stopped instantly by the emergency brake shown at the right.

By way of illustration, we have reproduced on this page some of the safety precautions used in the factory of the Packard Motor Car Company, at Detroit, Michigan. The factory is by no means a small one. In fact, it is one of the largest automobile factories, employing about ten thousand men. But in point of size, it is not to be compared with the United States Steel Corporation, for instance, which employs about two hundred thousand men. Nevertheless, the Packard Company has found that it pays to develop an elaborate safety system. At the head of its Bureau of Safety is an expert machinist, whose whole time is employed in installing protective devices, and educating workmen in precautionary measures. Every day he and his assistants make the rounds of the shop, hunting for uncovered flywheels, exposed gears, unprotected belts, projecting set-screws, and all other possible sources of danger to workmen.

Primarily, the shops were designed with a view to giving each machine more than the usual amount of working space, and plenty of daylight. One of the principal sources of danger in the ordinary machine shop arises from the crowded condition of the rooms, and the cluttered condition of the floors. Give a man plenty of room and plenty of light, and not only will he be less liable to injury from contact with moving parts of the machine, but his improved surroundings will react upon the work that he puts out. So far over five hundred different devices have been installed in the plant to do away with risk. These devices consist not only in the customary guards, but in other precautions, a few of which are shown in our illustrations. An elaborate forced draught system has been installed for drawing off particles of steel from the grinding room, so that this room is free from injurious dust. In the body plant, the aluminium bodies are prepared for paint by a blast of fine steel shot. So powerful is this blast that it would tear the toughtest oak frame to shreds. Hence the workmen must be protected, and they are furnished with heavy helmets which drop over their shoulders. One of the photographs shows a heavy hammer in the forge shop, fitted with a safety device to prevent a man from having his hand mangled. A safety cross bar projects across the table of the machine. To introduce the work the operator has to lift this cross bar. Then the hammer will not drop until the workman has removed his hand, allowing the safety bar to strike the machine base. Another special safety device is an emergency brake for a high-speed lathe. In case of accident, the machine can be checked instantly by the use of this brake.

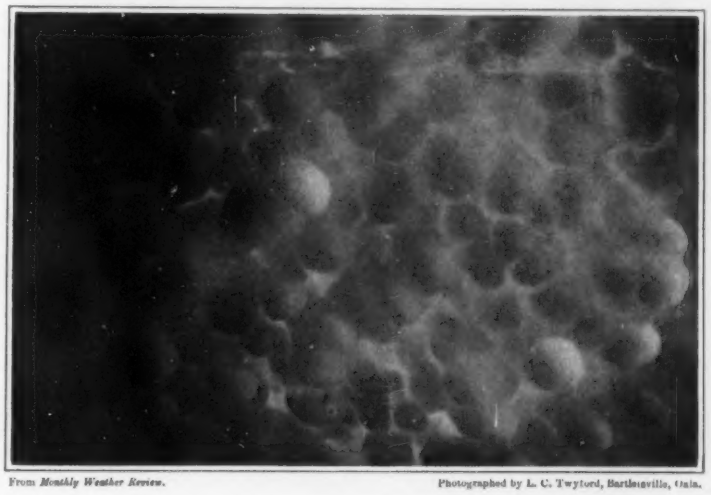
In the body plant the workmen are protected by heavy helmets from the blast of steel shot.

The Bureau of Safety at the Packard plant has been working only two years, but in that time the number of accidents in the factory have been decreased 60 per cent. Do safety precautions pay?

The Strangest Form of Cloud: Mammato-cumulus

THE accompanying photograph, which is from the collection of the United States Weather Bureau in Washington, is probably the most remarkable picture ever made of the rare variety of cloud known to meteorologists as *mammato-cumulus*. It was taken by Mr. L. C. Twyford, at Bartletsville, Oklahoma, who reports that about 45 minutes before these clouds were seen a destructive tornado occurred some 20 miles away in the direction from which the clouds came. Clouds of this type seem to be especially associated with a severe storm. They were seen by Prof. H. C. Frankenfield at St. Louis in connection with the tornado and just before it did so much damage in that city on May 27th, 1896.

The earliest description of mammato-cumulus appears to have been that contributed by the Rev. Charles Clouston to Dr. Mitchell's "Popular Weather Prognostics of Scotland" (1863), and subsequently in a work by himself on the same subject. In the Orkneys, where he resided, it was well known to seafaring men under the name of "pocky cloud" ("pock" or "poke" being a dialect term for a bag), and was regarded as a sure sign of a coming storm. Clouston compares it to "a series of dark cumulus-looking clouds, like festoons of dark drapery, over a considerable portion of the sky, with the lower edge well defined, as if each festoon or pock was filled with something heavy; and generally one series of festoons lies over another, so that the light spaces between resemble an Alpine chain of white-peaked mountains."



From *Monthly Weather Review.* Photographed by L. C. Twyford, Bartlesville, Okla.

Mammato-cumulus clouds.

This picture was taken looking up at an angle of 85 degrees; i. e., nearly perpendicular.

The characteristic form of this cloud is expressed by others of its numerous names, as "festoon-cloud," "mammiform cloud," "udder-cloud," and "sack-cloud." In Lancashire the festoons are known as "rain-balls," and are regarded as a sign of rain.

The peculiar feature of mammato-cumulus is that the rounded protuberances appear to project downward from the general cloud layer. Some writers have suggested that they are not really projections from the latter, but separate rounded clouds, having a more uniform sheet of cloud above them. Various other explanations have been offered.

A Portable Field Searchlight

By the Berlin Correspondent of the Scientific American

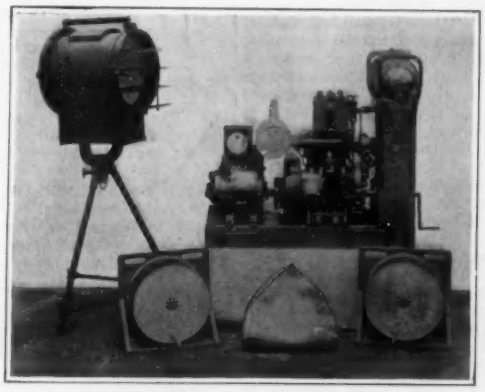
THE experience of recent wars has strikingly shown the benefit to be derived from skillfully operated electric searchlights. With the probability of night operations increasing in the wars of the future, the equipment of field armies with searchlights suitable for military uses has become a necessity. Now all the excellent systems adopted in actual practice, are designed to be conveyed on cars and therefore are difficult to handle on mountainous ground.

The Messrs. Siemens-Schuckert Works, which has taken such a prominent part in developing the electric searchlight, has succeeded in producing a portable field searchlight outfit, likely to comply even with the most exacting requirements. While using a very efficient parabolic glass mirror 35 centimeters (13.8 inches) in diameter of a range of 1,000-1,500 meters (3,281-4,921 feet) this outfit, inclusive of the gasoline, water and oil required for an 8 to 10 hour operation, weighs only about 300 kilogrammes (661 pounds).

The various parts of the set are designed to be transported most easily. They make four packages, each of about 80 kilogrammes (176.4 pounds), and are fitted up or taken apart in about five minutes. The operative parts, motor, dynamo and accessories, are fitted on a frame, readily moved to and fro by means of handles. The small searchlight, which is handled independently of the motive part, comprises two conductors each 100 meters (328.1 feet) in length (wound on cable drums), and all adjusting arrangements, inclusive of the tripod frame, weigh only 47 kilogrammes (103.6 pounds).

It will readily be understood that an outfit of so moderate weight, designed to be loaded on four animals walking independently of one another, should be able easily to follow an army even on almost impracticable ground, e. g., in the highlands on the steepest and most narrow mountain paths. The searchlight will be used advantageously both in signaling backward and in keeping up a connection with detached posts. It will also be found most useful in watching the course of a river, or a chain of lakes, if the vegetation on the banks is too dense to allow any searchlight cars to approach. Another case where the new outfit is likely to render valuable services is that of the equipment of expeditionary forces and detached troops, likely to encounter extremely difficult ground. On incursions in colonies and other territory, the addition of portable searchlights will prove of inestimable service, in exploring and defending the ground, the more so as the outfit can at the same time be used for signaling.

The portable outfit comprises a gasoline motor with radiator and fuel tank, a leather clutch and a dynamo, mounted on a common frame, a searchlight and tripod as above described, two cable drums, a water bag and the tool casing, the whole being readily carried by four mules in packages each of about 80 kilogrammes.



Complete outfit of the portable field searchlight.

The gasoline motor develops 4 to 6 horse-power at a speed of 1,500 revolutions per minute. It is equipped with a fly-wheel, magneto, governor and valve gear, cooled by an extra large thermosyphon radiator and fitted with a fan driven from the motor shaft. The oil tank and hand pump are fixed to the motor by means of a bracket. A leather clutch connects the motor with the shunt-wound dynamo, which at a speed of 1,500 revolutions per minute develops a tension of 65 volts and an intensity of 22 amperes. The inductor housing has been made of cast steel and the bearing brackets of aluminium, in order to keep down the weight. The most indispensable instruments and switches, an instantaneous switchout, a fuse, a voltmeter and two terminals for connecting up the two cables each 100 meters in length, have been provided. The motor, frame and radiator are fitted with handles allowing the whole set to be readily lifted.

The four packages carried by the mules comprise the following parts: First mule: Searchlight and supports, radiator and water and cooled gasoline tank. Weight, 82 kilogrammes (180.8 pounds). Second mule: Frame, dynamo, and leather clutch, switchboard and instruments, inclusive of the starter. Weight, 80 kilogrammes (176.4 pounds). Third mule: Gasoline motor and oil tank. Weight, 83 kilogrammes (183 pounds). Fourth mule: Two cable drums and 2 by 100 millimeters (0.08 by 3.94 inches) cable, filled water bag and tool casing. Weight 55 kilogrammes (121.1 pounds). The weight of the harness (saddle and accessories) varies between 27 and 30 kilogrammes (59.5 and 66.1 pounds).

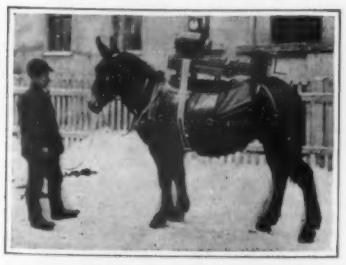
The Expanding Weather Map

ON January 1st the Weather Bureau began publishing at its central office in Washington a daily telegraphic weather map of the northern hemisphere. It appears on the reverse side of the ordinary weather map of the United States (i. e., the lithographic map issued in Washington, which is larger and more complete than the maps issued in other cities throughout the country), and is drawn on a circum-polar projection. Although the observations plotted on this map are not strictly synchronous (e. g., observations taken in Japan at 4 oclock yesterday afternoon, Washington time, are brought into comparison with those taken in the eastern United States at 8 o'clock this morning), they coincide nearly enough in time to make plain the broad features of pressure and temperature distribution, and especially the vicissitudes of the great "centers of action" to which weather forecasters attach so much importance.

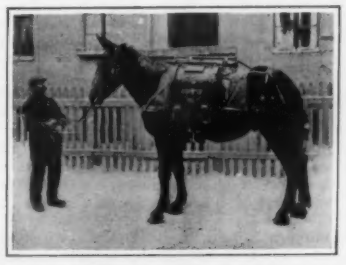
Aside from the compact network of reporting stations in the United States and Canada, the data on which the chart is based are rather sparse, the total number of other stations, including those in Alaska, being only forty-one; so that much of the map is obviously conjectural. This is a defect which will undoubtedly be remedied in time; probably through an agreement on the part of all civilized countries to exchange their weather reports by telegraph. The plan of a *réseau mondial* of this sort was a favorite idea of the late Teisserenc de Bort, and an international commission was formed some years ago to take steps toward its realization. The great blanks over the oceans, at present inevitable, will doubtless be partly filled up by wireless reports from marine observers, just as soon as the serious delays now involved in relaying messages from ship to ship have been eliminated or reduced to a minimum through improvements.

The United States Weather Bureau is to be congratulated not only upon being the first institution in the world to publish daily telegraphic weather maps of a hemisphere, but also upon setting the example of using on such maps dynamic units of barometric pressure (millibars) and degrees of temperature on the absolute scale. The isobars on the new maps are drawn for intervals of five millibars, and the isotherms for intervals of ten (in some places five) degrees absolute. Their appearance is neither strange nor confusing to persons habituated to the old units. The British Meteorological Office is planning to use these units on its regular daily weather map after May 1st of this year, and it seems certain that other countries will follow suit.

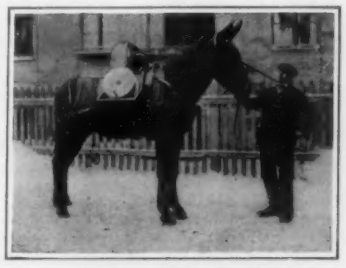
The advantages of the new units have already been set forth from time to time in the SCIENTIFIC AMERICAN.



Frame and dynamo, switchboard and starter.



Searchlight and support, radiator and gasoline tank.



Two cable drums, water bag and tool casing.

Motor, oil tank and exhaust vessel.

RECENTLY PATENTED INVENTIONS

These columns are open to all patentees. The notices are inserted by special arrangement with the inventors. Terms on application to the Advertising Department of the SCIENTIFIC AMERICAN.

Pertaining to Apparel.

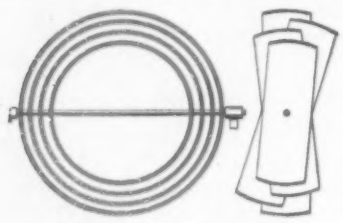
COLLAR SUPPORT.—L. M. GRAUBARTH, care of Josef Friedman, Inc., 114 Fifth Ave., New York, N. Y. The invention relates to negligee shirts having soft turned-down collars, and provides a support or stiffener arranged for convenient attachment to the collar to prevent the turned-down front portions of the collar from wrinkling up, and to hold the same in properly stretched positions, thus insuring at all times a neat appearance of the collar.

Electrical Devices.

ELECTRO-HYDRAULIC CONTROLLER.—C. ENGBERG, care of Engberg's Electric and Mechanical Works, St. Joseph, Mich. This invention comprises a system of valves particularly related with respect to means for controlling the valves, whereby the fluid may pass in different directions at will through the different chambers, a common outlet being provided.

ELECTRIC HAMMER.—J. O. FIELDS and R. L. FIELDS, 230 Downard St., Zanesville, Ohio. The principal object of the invention is to provide an improved contacting device especially adapted for use on electric hammers and adapted to be actuated by the beam of the said hammer whereby the distance through which the hammer head travels may be varied.

LOOSE COUPLED TUNING COIL.—A. C. GOWING and M. C. SPENCER, care of the former, 1 Lancaster Terrace, Worcester, Mass. This coil is for use in wireless telegraphy and other arts in the propagation of electric waves through space. It consists of primary and secondary windings, the former composing two sections which can be independently adjusted with regard to each other, and the latter likewise comprising two sections capable of independent adjustment, so that self-inductance of both windings can be regulated at will, and, at the same time, the mutual inductive effect of one winding upon the other can also be controlled with the utmost nicety.



LOOSE COUPLED TUNING COIL.

Of Interest to Farmers.

RESTRAINING DEVICE.—J. R. INABNIT, Witsall, Mont. The object here is to provide a device which may be readily adjusted on a cow, and which will prevent the cow from moving her hind legs or tail in such a way as might interfere with the operation of milking. It is of especial value for use on young cows.

HAY KNIFE.—J. F. SLUSSER, Jackson, Idaho. This invention relates more particularly to a hay knife embodying a cutter which is movable with respect to the handle thereof, the purpose being to do away with the body strain incident to the usual form of hay cutting knife in cutting hay in the stack. The knife is easily operated without assuming cramped positions or working upon the knees.

HAY KNIFE.

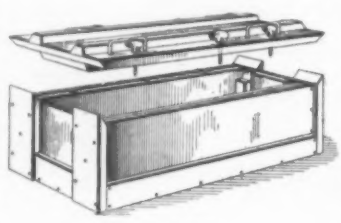
MEANS FOR IMPROVING LAND.—R. H. SPARKS, Terre Haute, Indiana. An object of the improvement is to provide a device by means of which sloping land that is being eroded from storm water, may be made to receive deposits of silt at certain places, and to maintain cultivation when said deposits are being made.

Of General Interest.

COLUMN.—J. F. MAY, 110 Conselyea St., Brooklyn, N. Y. This invention relates to columns of the type comprising a shell or casing of metal or other fireproof material designed to be filled with concrete, and the aim thereof is to produce an improved cap and base for the shell or casing forming the body of the column, so constructed that both the cap and the base will automatically center and lock themselves to the body of the column as soon as they are put in place.

MEANS FOR THE MAINTENANCE OF GAS IN CONFINEMENT.—S. R. BRETHERTON, 220 Mills Bldg., San Francisco, Cal. The invention relates to metallurgical and similar processes, and provides means for the maintenance of gas in confinement while agitating, decanting and refilling vessels with solutions either continuously or intermittently and without danger of free air from outside sources passing into the apparatus, thus preventing dilution of the gas and impairment of the decanting process.

ROUGH BOX.—W. M. GLOFELTY, Ohiopyle, Pa. This invention relates to receptacles used for holding caskets and coffins, and used more particularly for shipping the latter, whether the coffins be empty or contain human remains, at burial. The lid is self adjusting in the sense that when fitted approximately into position it will move into exact registry, thus making a perfect fit. The screw holes are thus brought into precise registry, so as to facilitate the application of the screws. Moreover, the various bevel surfaces of the body portion promote ease of handling the casket in that the casket as lifted into and out of the body portion of the receptacle, is guided to some extent by the bevels.



ROUGH BOX.

STERILIZING AND PRESERVING APPARATUS.—N. J. DARDEN, Memphis, Tenn. This invention provides a device by means of which articles which are to be preserved may have the surrounding air removed and replaced by a fluid sterilizing medium, such as ozonated air, carbonic acid gas, etc., and in which the articles so treated may be sealed hermetically, so as to prevent the spoiling or decaying of the articles so treated. Mr. Darden has invented another sterilizing and preserving apparatus by means of which the sterilizing medium may be passed through the receptacle which contains the food-stuffs, first one way and then the other, thereby insuring the thorough permeation of the sterilizing medium.

FLUX FOR ALUMINIUM SOLDER.—H. HAMMAR, Delhi, N. Y. In the present invention the improvement has for its object the provision of a flux of aluminium solder consisting of soft soap and beeswax which may be easily manufactured and may be used with a blow pipe with the aluminium solder.

HEAD GATE.—J. T. FITCH, Helper, Utah. The object of this invention is to provide a simple, strong, inexpensive and balanced gate which can be quickly and easily operated and which is provided with means indicating the size of opening made by the gate.

METALLIC BUILDING.—W. W. TAYLOR, care of J. H. Taylor & Bro., 219 Glenridge Ave., Montclair, N. J. This invention relates to metallic buildings adapted to be shipped in knocked-down form, and more particularly to a building especially adapted for use as a garage. The various elements may be assembled with the parts properly adjusted and secured without the exercise of great skill, and without great care on the part of the workmen.

PROCESS FOR PRECIPITATION OF ZINC.—F. L. WILSON and S. E. BRETHERTON, care of latter, 220 Mills Bldg., San Francisco, Cal. The purpose in this invention is to obtain a constant precipitation of metallic zinc from an electrolytic bath and obviate the necessity of installing reduction furnaces for the production of the same.

STOPPER CAP.—R. H. MOLONEY, 315 73rd St., Brooklyn, N. Y. Among the principal objects which the present invention has in view are: to provide for bottle stoppers a detachable cap; and to provide a cap for the purpose set forth having a screw thread adapted to cut or sink into a cork of conventional construction.

BOOK MARKER.—W. A. OVERBECK, 822 E. Cleveland Ave., Salt Lake City, Utah. This invention relates more particularly to a member adapted to clamp a page. An object is to provide an inexpensive and simple book marker that will have a firm grip on the paper and will not injure or mar the page in places of contact with it.

GLASS CLEANER.—L. G. HATOSY, JR., 604 E. 135th St., New York, N. Y. This cleaner permits the barkeeper or other person to conveniently, quickly and thoroughly clean the glasses, and to allow of setting the cleaner into the washing or rinsing tank of a bar or of removing it therefrom whenever it is desired to do so for replacing worn out brushes by new ones or for other purposes.

HAME CLIP.—W. A. PICKARD, care of Mead & Whitcomb, 411 Sunset Bldg., Bellingham, Wash. This invention provides a clip so attached to the hame that weakening of the latter is avoided, and so connects the movable part of the clip to the stationary part carried by the hame that freedom of movement will be provided so that the trace will pull at right angles to its securing bolt, whereby strain against the animal's shoulders will be evenly distributed and splitting of material forming the trace, usually due to angular pull thereon, will be avoided.

Hardware and Tools.

COMMUTATOR SLOTTER.—F. R. ALLEY, 703 Ninth Ave., Seattle, Wash. The improvement refers to a hand tool for slotting commutators, and it has for its general object the provision of a tool whereby the slots between the commutator bars of a dynamo-electric machine can be quickly and accurately made and with uniformly good results.

CIGAR TUCK CUTTER.—G. W. BOWMAN, 409 S. George St., York, Pa. This invention relates to cutters or trimmers for use by makers of cigars for trimming the ends or tucks thereof. It improves and simplifies the construction of the cigar cutters so as to be reliable and efficient in use, comparatively inexpensive to manufacture, and so designed as to insure a uniform size of cigar.

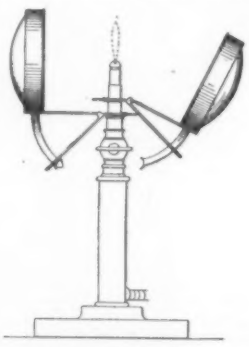
STRIPING TOOL.—J. E. SCHMANDT, Harrington, Wash. This improvement has reference to striping tools for use by painters in wagon work and the like; and particularly to that class of tools in which the handle forms a container for the paint, and has means for detachably holding a striping brush.

WRENCH.—J. SONTHEIMER, 1146 Emerson St., Lincoln, Neb. This invention relates to improvements in wrenches, and has for an object to provide an improved self-adjusting wrench which will automatically grip pipes, bolts, nuts and the like, without manipulation of any adjusting members.

LOCKING DEVICE FOR HAND DRILLS.—G. L. WILCOX, 167 W. 71st St., Manhattan, N. Y., N. Y. The purpose in this instance is to provide a new locking device for hand drills more especially designed to enable the user of the drill to readily and quickly manipulate the drill chuck for the insertion, fastening or removal of the boring or drilling tool.

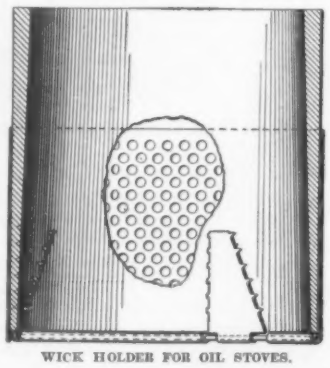
Heating and Lighting.

LIGHT INTENSIFIER.—G. LINDE, 23 John St., New York, N. Y. This invention relates to illumination or lighting apparatus, and has particular reference to easily and adjustably controlled means for increasing the light from a gas jet or any other suitable source of light for any purpose such, for instance, as for the use of workmen or artisans on a bench or the like. The lens meets the requirements of any particular user without interfering with or disturbing any other similar lens holders which may be located on the same jet.



LIGHT INTENSIFIER.

WICK HOLDER FOR OIL STOVES.—JOHN F. BITTLE, Lisbon, Iowa. The common form of a wick holder consists of a perforated cylindrical shell, the lower end of which is inturned and forms a binding over the wick, at the inside of the holder. As the wick in the old holder mentioned is permanently secured in place, it cannot be renewed, so that a new holder is required to renew the wick. In the present invention a novel clamping means is provided in connection with the holder, to detachably engage the wick, so that the remnant of a burned wick may be readily removed and a new wick secured to the holder.



WICK HOLDER FOR OIL STOVES.

HEATING SYSTEM.—P. ROBERT, 54 Rue Lepic, Paris, France. This invention has for its object an arrangement for generating pressure and maintaining the same in steam generators without the use of fuel and the invention may be applied for instance to the so-called mixed electric plants, comprising electric machines combined with hydraulic and steam engines.

Household Utilities.

BATH SHOWER.—C. S. C. ROCK, 204 W. 140th St., New York, N. Y. This bath shower occupies a small amount of space and requires the least amount of manipulation to bring it into or throw it out of action. The apparatus dispenses with the necessity for a hood or apron to prevent splashing of the water over the bathroom floor.

SADIRON STAND.—M. LEVY, care of G. K. Bartlett, 620 First National Bank Bldg., Oakland, Cal. This invention is a reversible stand or support for heated sadirons or so-called flatirons, and it is formed of a flat body produced by winding a strip of asbestos, and a metal band encircling the same and provided with a lateral handle, constructed integrally with the band. A series of rods extend through the body parallel to its surface and serve to reinforce the same so that it remains flat under all conditions of use.

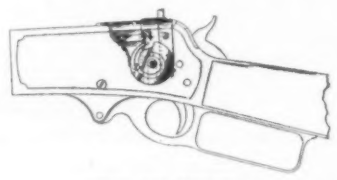
FASTENER FOR IRONING COVERS.—T. M. BROOKMAN, 762 Spaulding St., Elmira, N. Y. This fastener is arranged to permit of conveniently and properly stretching the cover over the board and securely fastening the same in place on the board, and to permit of removing the cover from the board for removal and renewal of the facing sheets of the body of the cover.

WINDOW SHADE FIXTURE.—A. DANGLO, 175 Clinton St., Brooklyn, N. Y., and L. RESCH, N. Y., N. Y. This invention provides retainers for the edges of window shades to normally hold the shade in desired positions; and provides means whereby if the shade is forced out of normal position, the same may be returned without further damage to the fabric thereof.

Machines and Mechanical Devices.

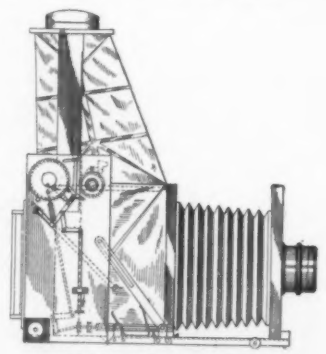
COMPOUND LEVER.—W. V. GILBERT, London, England. Address Day, Davies & Hunt, 321 High Holborn, London, England. This invention has for its objects to construct a compound lever which will be compact and will enable the equivalent of an almost completely extended long limbed toggle to be utilized in the transmission of movement, so that an efficient and sustained leverage is available, and which may be adjusted to enable different operations to be obtained from a given actuation.

SIGHT FOR FIREARMS.—M. P. NASH, U. S. Navy, care of George C. Lawrence, 317 Washington Ave., Brooklyn, N. Y. This invention provides a sight for rifles and other firearms, and is arranged to permit the user of the firearm to conveniently and accurately raise or lower the eye-piece of the sight for different ranges to visually indicate the range to which the eye-piece is set, and to audibly indicate a change in setting the eye-piece. The engraving shows a side elevation with the sight fitted to a rifle. The inventor and his partner, Lieut. Commander J. M. Enochs, U. S. N., recently tested out the sight on the Government range at the Navy Yard, Mare Island, with very good results, it being fitted at the time with one of the new Springfield rifles.



SIGHT FOR FIREARMS.

CAMERA.—ANTHONY VORIS, 15 Cottage St., Jersey City, N. J. This invention relates to photographic apparatus, particularly to devices known as folding reflex cameras. It permits the operator to view a full size non-inverted image up to the moment of exposure. The apparatus of which a side view of a slightly modified form is shown in the engraving, may be folded into a very compact casing or housing when not in use. Means provide for automatically and quickly erecting the focusing hood and mirror upon dropping the baseboard and *vice versa*. Provision is made for the use of a pleated bellows when long focus lenses are used, and their removal for short focus lenses. This apparatus has in addition many other novel features of construction and operation.



FOLDING REFLEX CAMERA.

COMBINATION LOCK.—H. C. STEVENS, Jenkins, Ky. This invention provides a lock wherein a plurality of tumblers is arranged between the bolt and the rotating operating knob having means for engaging and moving

the bolt when moved toward the bolt, the knob also having means for engaging and turning the tumblers, to bring them into position to permit the passage of the engaging means of the knob.

CONFETTI MACHINE.—G. G. GRIFFIN, care of Arn Mfg. Co., 63 Wall St., N. Y., N. Y. This invention relates to an apparatus for making confetti, and the object is to devise a mechanism by means of which a number of sheets of paper or cardboard can be divided into a number of small pieces of regular shape, with little or no waste of the material employed.

HEAD GATE.—J. Z. HANSON, care of Milwaukee House, Deer Lodge, Mont., and W. D. THOMAS, Aberdeen, Idaho. The improvement is capable of embodiment either in a permanent head gate, or in a portable head gate adapted to be located at any point in a ditch, to raise water therein where desired. Valve means are provided for commanding the opening in the gate, and a novel arrangement of manually-controlled operating rod and guide therefor.

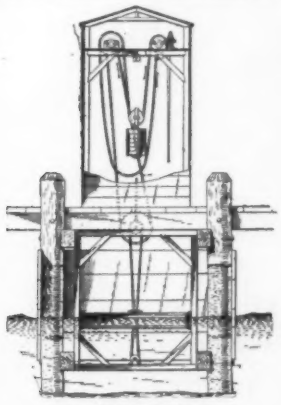
SAFETY DEVICE WITH COMBINATIONS FOR LOCKS OF ALL KINDS.—L. J. M. DARDEAU, 25 Rue de Lyon, Paris, France. The results accomplished by this device are due not only to the movableness of the safety elements or members located in the lock, but also to a key having removable members or counterparts in order that the change of the safety elements or members effected in the lock can also be effected instantaneously on the key, to allow of obtaining the necessary cooperation between these two parts of the lock.

WASHING OUT AND REFINING MACHINE.—H. PAATZ, 2 Vogelgesang, Burg, near Magdeburg, Germany. This invention relates to starch making machinery, and its object is to provide a washing out and refining machine arranged to effectively separate the starch from the pulp, and to allow of carrying on the washing out and refining operations in a single machine.

MITERING MACHINE.—F. MAXIMILIAN, 531 W. 37th St., New York, N. Y. This machine is more particularly adapted for glassworking. The principal object is to provide a machine especially adapted to miter glass through the aid of suitable tools, the construction and arrangement being such that the feeding means for the said tools is avoided.

Prime Movers and Their Accessories.

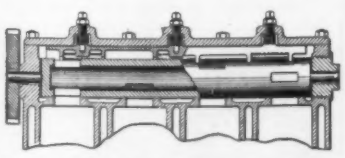
TIDE MOTOR.—W. BRAUNSDORF, 3440 Broadway, N. Y., N. Y. This invention relates to tide motors and particularly to power



TIDE MOTOR.

devices of this character adapted to operate substantially automatically in accordance with rise and fall of the tide. A float and means are provided to control the vertical reciprocations thereof with the tide and to cause the float to automatically grip an endless chain to cause the same to be operated from the float while the latter is rising or falling. The power storage device when detached from the tide motor can be applied to store power on windmills, and can be used as a hand weight motor for home use. The inventor claims that the power produced by his tide motor will cost one third of the price of electric power.

VALVE FOR INTERNAL COMBUSTION ENGINES.—O. ERNST, Larchmont, N. Y. The valve is preferably of the rotary type, and the inventor's object is to provide a construction of this sort in which all defects inherent in rotary valves for gasoline motors are elimin-



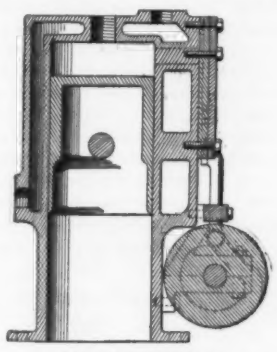
VALVE FOR INTERNAL COMBUSTION ENGINES.

ated. To this end he constructs a valve with spindles that are so mounted as to have a certain degree of lateral play in the bearings which receive them, and he provides resilient means to hold the valve against its seat without opposing any appreciable friction to the movement of the same.

VALVE PACKING.—S. M. PURINGTON, 232 Bay View Ave., Jersey City, N. J. The primary object here is to provide a form of packing which will be associated with a valve in such a way as to make the same fit snugly at all times to its seat and totally eliminate leakage of steam or other fluid between said valve and the sides of the casing in which the same is contained.

GASOLINE FILTER.—C. A. PORT. Address Fred Catchpole, Pagosa Springs, Colo. This simple device is adapted to be interposed between the source of supply and the carbureter for thoroughly and automatically purifying the liquid fuel, and wherein means is provided for shutting off the supply of fuel when the filter needs cleaning.

GAS ENGINE VALVE.—F. C. GONZALES, care of Ripley Congregational Church, Traer, Iowa. This invention is an improvement in gas engine valves, and has for its object, the provision of a direct acting valve for use with



GAS ENGINE VALVE.

engines of the character specified, which will be comparatively noiseless in operation, simple in construction and in operation, accessible for the cleaning or the like, and having a large bearing surface, so that wear is reduced to a minimum.

PISTON RING.—H. H. PATRICK, 50 Sandwell road, Handsworth, Birmingham, England. This invention relates to piston rings, for, more especially, internal combustion engines, although it is not limited to such rings, being applicable to cast iron and steel piston rings for a variety of purposes. In this invention the method of making split piston rings consists in the employment of a pair of similar and coaxial metal rings and uniting a pair of opposite overlapping ends along a portion of their adjacent side faces by welding.

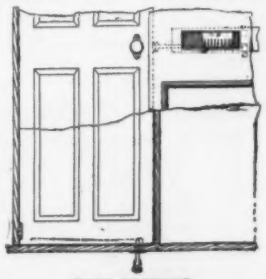
EXPLOSION MOTOR.—JAMES MACCONAGHY, deceased, Boulogne-Sur-Mer, France, care of Charles Philips, 1122 Mission St., San Francisco, Cal. In the present patent the invention has for its object an explosion motor of the multiple cylinder type, capable of developing a great horse-power under a small volume and applicable by this fact, either to motor vehicles, or to apparatus for aerial locomotion.

Railways and Their Accessories.

CAR COUPLING.—C. A. MCKERAHAN, 420 Air Brake Ave., Wilmerding, Pa. This coupler is provided with a block for locking a tail piece of the knuckle, there being a lever, one arm of which is adapted to be engaged by the block, the block on the other arm of the lever engaging the cam surfaces of the tail piece to operate the knuckle as the block is raised or lowered. Means provide for raising or lowering the block from the side of the car.

SMOKE CONSUMER.—J. O. RICHARD, 515 Michigan Ave., Hammond, Indiana. The principal object here is to provide a smoke consumer especially adapted for use on locomotives, whereby the boiler pressure is utilized to provide a draft in order to carry back the products of combustion into the fire box after such products have been mixed with a desirable quantity of air.

FARE REGISTER.—L. J. HARRIS, Albany, Ga. This invention comprehends mechanism controlled partly by the weight of the passenger entering the car, and partly by a voluntary or manual act of the passenger independ-

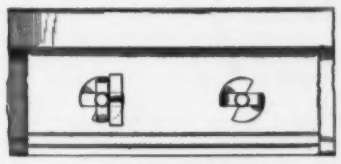


FARE REGISTER.

ently of his weight, for preparing a record of the number of passengers taken aboard at various stations, and also for indicating respectively the various destinations for which the several passengers are bound.

MEANS FOR SUPPORTING AND RELEASING RETAINING STAKES.—J. D. MAUCH and F. MARTIN, Rib Lake, Wis. This invention provides a casing having means whereby it can be secured to the bolster of a car, which is provided with a bolt having locking means. A shoe which carries the stake has means adapted to engage the casing and to be secured by the bolt to the casing, with the locking means preventing the accidental displacement of the shoe from the casing.

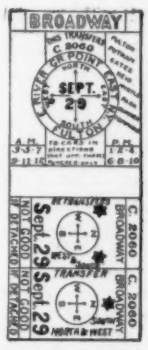
BOLT.—J. S. WAIT, JR., and A. HALLIDAY, care of the former, 324 Third Ave., Two Harbors, Minn. This invention is an improvement in bolts, and has for its object the provision



BOLT FOR USE WITH FISH PLATES.

of a bolt for use with fish plates for connecting rail ends so constructed that the fish plates may be clamped together on the rail ends, and held firmly in such position, without the necessity of threaded holding nuts and bolts.

TRANSFER TICKET.—W. KLEIN, JR., 11 Devoe St., Brooklyn, N. Y. This ticket is particularly designed and adapted for use in transferring passengers from one line of cars to intersecting lines, and for this purpose the ticket



TRANSFER TICKET.

is composed of a body or main portion, transfer and retransfer portions having various peculiarities. The accompanying engraving represents the transfer, which is a composite ticket.

RAIL JOINT.—J. W. ENRIGHT, 862 Tchoupitoulas St., New Orleans, La. This invention relates to railway construction and has particular reference to means for connecting the adjacent ends of the railway rails. Among the objects is the provision of a rail joint which may be rolled and which, when in assembled position, serves to clamp the rails in a peculiar vise-like manner.

MEANS FOR THE INTERCHANGE OF MESSAGES BETWEEN A STATION AND A MOVING CAR.—O. H. SMITH and J. L. SMITH, Stratford, Pennsylvania. Address the former. This invention relates to mechanism of the character set forth in a previous patent, No. 1,042,983, issued to these inventors. It provides a system of tubing leading from a railway station or other building in the proximity to a railway track, such tubing being adapted to deliver carriers to and from a car, such carriers being received and deposited by the car as it moves along.

Pertaining to Recreation.

HAND BALL GLOVE.—J. I. BROKAW, 160 W. 66th St., Manhattan, N. Y., N. Y. The purpose in this case is to provide a glove with which it is possible for a player to return the ball accurately, and with great speed. In the game of hand ball, gloves are worn not as a protection for the hand, but to increase the efficiency of the player.

Vehicles and Their Accessories.

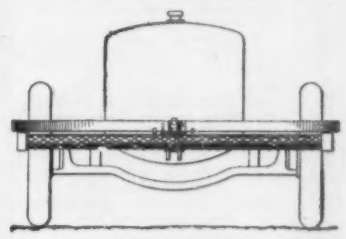
TIRE DEFLATING CAP.—J. H. HARD, Allen, Neb. A cut of the device appeared in this journal November 22nd, 1913. It consists of two caps joined at their bases; either cap screwing upon a valve stem; one serving as a valve cap, the other having a central pin depressing the valve, releasing air through holes in the wall of the cap. Also a core remover with a base which screws into either cap, where it may be carried when not in use.

SPRING WHEEL.—C. N. SNOWDEN, Soledad, Guantanamo, Cuba. This invention pertains to spring wheels more particularly designed for use on automobiles, and more especially to that class in which there is an inner hub and spoke section having a rim, and an outer tire rim. The invention provides a novel spring means affording a cushioned connection between the inner rim and the tire rim.

VARIABLE SPEED MECHANISM.—D. E. CROUSE and C. G. EIDSON, Annapolis, Md. This invention provides a mechanism for use in automobiles and similar vehicles which will dispense with the noise ordinarily occasioned when gears are brought into mesh. The invention provides a variable speed mechanism in which the changing of the speed is accomplished by the mere shifting of a switch in an electric circuit.

AUTOMOBILE LAMP.—W. F. DOERNER, Box 96, Cumberland, Md. The present invention relates to automobile lamps, and particularly to that character of lamps and their attachments by which the lamps are caused to turn on vertical pivots for the purpose of following the direction of turning movement of the machine, connections between the lamps and steering gear being had for this purpose.

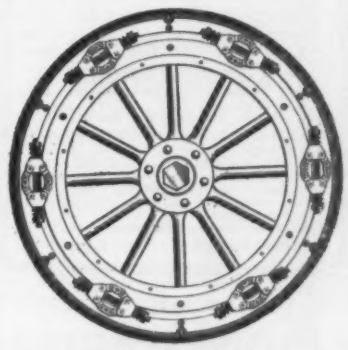
VEHICLE FENDER.—D. GHEZZI, care of C. Zerbani, 346 Broadway, N. Y., N. Y. Among the principal objects which the present invention has in view are: to provide an apparatus of the character named having a yielding buf-



VEHICLE FENDER.

fer and grasping arms arranged to support a body from falling; and to provide means whereon the body may rest, or recline after being lifted from the ground. A buffer may be placed sufficiently low to catch and carry a child while arms may be disposed so that if the buffer be struck, they will grasp a person at the height of the hips, waist or shoulder.

RESILIENT TIRE.—R. CURRY, 1436 Prospect Ave., Bronx, N. Y., N. Y. The intention here is to do away with the necessity of using rubber tires, by providing a tire made up of parts of rigid material which are connected together so as to be movable with respect to



RESILIENT TIRE.

one another, and so constructed that the same can be applied to almost any wheel now in use. The extent to which the principal parts are movable is regulated by cushioning devices or suitable resilient means which are introduced between the same, and the whole is suitably incased to guard against the intrusion of mud or dirt when the same is in service.

NON-SKID TIRE SHOE.—H. STRONGSON, 68 E. 97th St., Manhattan, N. Y., N. Y. This invention provides an article having spaced-apart members moving relative to the tire to form independent gripping sections to permit movement of the tire thereon; provides resilient means for returning the gripping sections to normal position; provides for adjusting the shoe to wheels and tires of different dimensions; constructs an article to permit the removal for repair or replacement of sections thereof; and provides an article which may be folded or packed within small compass.

Designs.

DESIGN FOR A DOLL HEAD.—J. G. KAEMPFER, care of Maurice L. Shaine, 350 Broadway, N. Y., N. Y. In this ornamental design for a doll head, the head is round, the face chubby, the eyes very large and the mouth open. The hair is smooth except a slight wave and a lock curling down the forehead.

NOTE.—Copies of any of these patents will be furnished by the SCIENTIFIC AMERICAN for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

WE wish to call attention to the fact that we are in a position to render competent services in every branch of patent or trade-mark work. Our staff is composed of mechanical, electrical and chemical experts, thoroughly trained to prepare and prosecute all patent applications, irrespective of the complex nature of the subject matter involved, or of the specialized, technical, or scientific knowledge required therefor.

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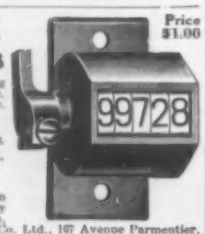

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Safety in Steel Works

(Concluded from page 122.)

which was provided, at heavy expense, in a pipe mill of the National Tube Company at McKeesport, Pa. When the building was erected no provision was made for the cleaning of the windows in the sawtooth roof. The window cleaner had to cling to the molding and the steel work of the roof while cleaning the inwardly slanting windows, and accidents were not infrequent. Accordingly, tracks were laid along the windows and a trolley provided to run the entire length of the building. As the wheels of the trolley have ball-bearings, one man can easily move the vehicle along as he cleans the windows.

No machinery is now bought by the Steel Corporation without provisions for safeguarding all possible points of danger. In the two pictures of a bevel gear, which we illustrate, one shows the gears completely covered and all the oiling lids closed, while in the other the guards have been removed to show the gears, which were at one time uncovered and constant menaces to the lives and limbs of the workmen. The company's draughtsmen in designing new machines or making repairs for old machines have the safety idea constantly before them. They are required to make sure that all gears are covered, that all couplings are recessed, etc., and that every possible source of danger is guarded against. Every blueprint must be checked by a safety inspector in order to make sure that it comes within the regulations.

A common source of danger may be found in the ordinary planer with its open bed between the ways. The machinist who operates this planer is quite apt to use this space for storage purposes, and he is liable to have his hand caught by the table as he reaches down into the bed for something. We have heard of an accident in which a man stuck his head down into the bed in search of something, and the returning table promptly decapitated him. Accordingly the ruling has now gone forth, that the planer beds must be covered with sheet iron. Even the oil wells in a planer's ways must be covered. In one of our photographs may be seen the "skull cracker" with which large castings are broken up. The skull cracker is an enormous ball of iron which is lifted by an electromagnet. On demagnetizing the electromagnet the ball drops, striking the casting with a powerful blow. Flying fragments make this operation dangerous. The customary barrier of boiler iron riveted to a steel frame has been found inadequate; for sometimes the fragments are thrown with force enough to cut clear through the barrier and injure people outside. This led to the erection of another barrier within the boiler iron wall, consisting of a series of iron tubes supported upright in a concrete base and filled with concrete, so as to form a stout stockade. The force with which the fragments sometimes strike this stockade will be noted in the accompanying illustration by the dents made in the pipes. One of the pipes near the right-hand side of the picture will be seen to be cracked. Unfortunately lack of space prevents us from illustrating the thousands of different safety devices, many of them exceedingly interesting, that have been developed in steel plants.

The organized safety movement of the United States Steel Corporation dates from 1906. In 1907 the rate of accidents was reduced to such an extent that 532 men were saved from serious injury. By the end of 1912, 8,801 persons had been saved. Surely this record shows that the work is worth while even if all humanitarian considerations be ignored.

The American Museum of Safety

(Concluded from page 114.)

by suction. The most striking part of the Pulmotor is a small leather accordion bellows, which effects the automatic reversal of the apparatus from suction to delivery, and *vice versa*, when essential. The bellows is connected with the air tubes. During inflation, the same pressure obtains in the bellows as in the lungs, and as soon as the latter are filled, the bellows becomes inflated, and in moving forward, causes the valve to be automatically reversed into position for suction. The operation is now reversed, and as soon as the lungs have been emptied, the bellows contracts and automatically reverses the valve again into position for inflating—and so on.

The medal was awarded for the fifth time last December to the Welin Marine Equipment Company for a chain of safety devices, including the Welin davit and the Lundin lifeboat. These devices have been fully described in the SCIENTIFIC AMERICAN for December 20th, 1913. Lifeboats are like a fire escape, they are wanted desperately when they are wanted at all, so that the boats themselves must be safely launched and kept afloat until succor arrives. The boats described in that issue fulfill admirably all the requirements of safe operation.

Such in brief is the history of the SCIENTIFIC AMERICAN Medal. The high class of the devices honored speaks well for the professional ability of the juries, the members of which have included some of the most eminent engineers in the country.

Proposed Improvement of the Patent Office

FOR many years the storage of the important records of the Patent Office as well as of the many copies of patents which have accumulated beyond all anticipation, has caused much concern. Many of the halls of the Patent Office are crowded with the accumulation.

It is now proposed to excavate the open court of the Patent Office to a sufficient depth below the present surface to provide a two-story storage place of about 15 feet, giving a headway of 7½ feet in each story.

The roof of the structure, so provided, is to be covered with soil and grass as at present with the walks covered with vault glass to admit sufficient light.

The intermediate floor of the storage place will be of metal grating so that light and air may circulate freely between the floors, and the Ninth Street end of the structure is to be made fireproof for the storage of the valuable records of the Office.

By leaving a space of seven or eight feet all round the court structure, sufficient ventilation may be secured and the structure adapted for the storage of patent copies and other records, but it is not contemplated that any part of the structure shall be utilized for work rooms.

The appropriation of $220,000 to erect a building has already been granted, and it is now proposed to ask Congress to permit the use of this appropriation for the building of the vault space.

By the proposed arrangement all patent copies can be stored at one place, avoiding the distribution thereof throughout practically the entire Patent Office building as at present. This will facilitate not only the business of the Patent Office in securing the copies for its own use, but also facilitate the delivery of copies to attorneys and others in the transaction of business, while a perfectly fireproof compartment for the valuable records of the Office, at present exposed to fire risk, will be provided.

The Eruption of Sakurajima

ON January 12th the volcano Sakurajima, in southern Japan, burst into violent eruption. This volcano, which according to Naumann, was formed in the year 718 A. D., occupies the middle of the island of Sakura, opposite and a few miles distant from the large city of Kagoshima (the center of the Satsuma rebellion and of many other important events in the history of Japan). Both Kagoshima and the neighboring volcano are favorite resorts of occidental travelers. Sakurajima has had seven previous eruptions, all of them explosive, the latest in 1860. A much more violent one occurred in 1779; this produced such an impression that it has been commemorated locally ever since by a monthly festival.

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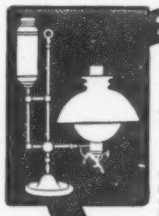

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the island of Sakura, amounting to upward of 25,000, escaped to the neighboring mainland, though several hundred were either overwhelmed by the eruption or drowned in attempting to swim across the channel. About half of the 3,500 houses in the island were destroyed.

The eruption was accompanied by frequent shocks of earthquake, which, though not of extreme severity, did some damage in Kagoshima, and the city was also invaded by waves from the bay. Most of the inhabitants of Kagoshima closed their houses and fled. About twenty casualties occurred here.

After partially subsiding a renewal of volcanic activity occurred on the night of the 16th. Simultaneously with the eruptions of Sakurajima the volcano of Kirishimayama, lying about 30 miles farther north, was in eruption, and violent rumblings were heard from Aso-san, the largest volcanic crater in the world, belonging to the same group.

Prof. F. Omori, Japan's leading vulcanologist and seismologist, is quoted in press dispatches as having expressed the opinion that the whole volcanic range of Kiusiu has entered upon one of its recurrent periods of activity, and that other eruptions are imminent.

Dried Fruits and Their Use

IN the yearbook of the Department of Agriculture for 1912, there appears an article prepared by C. F. Langworthy on raisins, figs, and other dried fruits and their use.

To determine which of two fruits is really the more economical, says Mr. Langworthy, one should know not only the cost of each per pound, but also the amount of protein and energy a pound would supply, and should take into account the amount of material, fuel, and labor required to prepare the two foods for the table. Grapes commonly cost less per pound than raisins, but a given sum spent for fresh fruit will buy a smaller amount of nutritive material, since the proportion of water is much higher than in the raisins. On the other hand, one can think of circumstances under which low-priced fresh fruit, which may be eaten as purchased, would in the end be as economical as a somewhat cheaper dried fruit, since the latter would require sugar and fuel and time to make it ready for the table. Such considerations as the ease of obtaining a supply, convenience of use, the liking for a particular product, and many other things besides cost must also be taken into account in comparing dried with fresh fruits. Attention should also be directed to the question of refuse, or inedible material. If seeded and unseeded raisins cost the same price per pound, the former would be more economical as well as more convenient, since the purchaser would not have to pay for the seeds.

As a whole, dried fruits can be called reasonable in price as compared with other common articles of diet. This has been shown by numerous studies made in connection with the nutrition investigations of the Office of Experiment Stations. Some less general comparisons may also be made from the results of such studies. For instance, it appears that practically all the fruit products contain little protein, and as sources of this food constituent are so much more expensive than the cereals and dried legumes and most animal foods that there is practically no comparison between them. However, as sources of energy, derived almost entirely from their sugars and other carbohydrates, dried fruits are decidedly cheaper than meats, and compare favorably with dairy products, but are more expensive than cereals and starchy vegetables, such as dried beans and potatoes. When compared with one another, the differences in composition are relatively small, so that the selling price of different sorts of dried fruits is the main point when one is considering relative economy. This means that the housewife who wishes to economize can secure as much nutritive material from dried apples at a low price per pound as she can from a fancy grade of dried apricots at a much higher price per pound, though the flavor may not please her so well.

When every penny spent for food must bring the largest returns in actual nutritive value, questions of flavor and attractive appearance are of secondary importance, but when the income allows a range of choice, it is perfectly justifiable to consider them, and a family which can afford expensive meats and selected grapefruit can also purchase fine layer raisins for use as dessert, and fancy brands of other dried fruits. In the family where means are limited, the cheaper sorts must be chosen, but under any circumstances fresh and dried fruits should not be thought of as a luxury, since they may be used as an integral part of the diet to supply needed nutritive material, as well as add to the attractiveness and palatability of the daily fare. If they are to be eaten raw, care should always be taken to select brands which are made and marketed in a cleanly way, and most persons would prefer to pay a few cents more per pound, if necessary, to be certain that the brands are of this character. Dried fruits in sealed cartons or packages are much less readily soiled in market than those sold from open boxes. Unfortunately, neither price nor appearance is necessarily an index to cleanliness, and it is often difficult for the ordinary buyer to know where and how dried fruit was prepared and marketed. Those who are familiar with the facts in the case believe that the use of evaporators and other mechanical devices results in a much cleaner product than the old-fashioned methods, and that American dried fruits are the equal of any in this respect, and much more cleanly than those which are imported from Mediterranean regions. In using dried fruits in cookery every attempt should be made to secure clean, wholesome goods, to remove any bits of stem or other material accidentally present, and to wash the fruits before using them if they are not already clean. The heat of cooking will sterilize them, to be sure, but most of us prefer material which we do not need to sterilize to render it safe and wholesome.

Whether used by themselves as substitutes for fresh or preserved fruits, or mixed into cakes, puddings, confectionery, and other dishes, dried fruits offer a wholesome, nutritious, and economical way of securing variety in the diet, and are especially useful where the supply of fresh fruits is limited, or where storage space for fresh fruits is lacking.

Variations in Atmospheric Ozone

By Harry N. Holmes

THE existence of ozone in the atmosphere has often been disputed and the tests obtained ascribed to hydrogen peroxide, nitrogen peroxide and other compounds occasionally found in the air. Recent experiments, however, prove that variable amounts of ozone do exist in the lower air, though probably not more than one part in seven hundred thousand. The most conclusive test known is that with the so-called "tetramethyl base" paper. To be exact it is really tetramethyldiamidodiphenylmethane. A very small amount of this powder is dissolved in water containing a little acetic acid and strips of white filter paper are partly immersed in the solution. Ozone turns the exposed portions of the paper violet, while nitrogen peroxide turns it yellow, and hydrogen peroxide has no effect.

Various theories are advanced to account for the presence of ozone in the atmosphere. The electric discharge during thunderstorms is a favorite cause, though such an explanation is hardly in accord with the fact that in winter when there is very little thunder and lightning the air is richest in ozone. Besanez ascribes its formation to the rapid evaporation of water, yet other scientists insist that rapid evaporation of water in the sunlight produces hydrogen peroxide, thus accounting for the beneficial effects of sea air.

The most probable causes, however, are found in the silent electric discharge such as the aurora borealis and the action of ultra-violet rays of sunlight on cold, dry oxygen. Ladenburg and Lehman have

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shown that ozone has a number of absorption bands scattered over a wide range of the spectrum, and by a study of these bands Angström detected the presence of a large amount of atmospheric ozone. Naturally since little of it is found in the lower air it must lie in the upper air.

Humphreys demonstrated that a blanket of ozone around the earth would be much less permeable to earth radiations than to solar rays and must therefore act as a temperature regulator. Ultra-violet rays of sunlight undoubtedly convert oxygen into ozone, but, unfortunately for us, these rays are absorbed by air so that only a small fraction reaches the lower air. In the upper strata this ozonizing action is great, thus accounting for the presence of considerable amounts of ozone several miles above the earth.

It is evident that any decrease in the sun's radiation must be followed by a decrease in the formation of this ozone blanket, thus permitting more of the earth's heat to escape. Humphreys observed that sun spot maxima were always accompanied by a decrease in terrestrial temperatures many times that which could be accounted for by the decrease in radiation from the spot areas alone. A compensating effect in high latitudes is the action of sun spot maxima in increasing auroral displays, which in turn form increasing amounts of ozone. In equatorial regions there is no such compensation, so the upper air in the torrid zone must have a greater diathermacy to earth radiations. This results in the comparatively low temperature and great elevation of the equatorial isothermal air. This hypothesis is sustained by the facts, for the isothermal air in the tropics is two miles higher and 27 deg. Fahr. colder than in middle latitudes.

The theory and evidence given above receive further support from the weather observations of the author, carried on for a period of nearly two years. Only approximate measurements of the variations in the ozone content of the atmosphere were made, but this record is of considerable value. One of the most striking observations made was that thunderstorms—always supposed to form what little ozone the lower air contained—were really of minor importance in this connection. Any clear, snappy winter day will yield better ozone tests than the liveliest kind of a summer thunderstorm. Furthermore, since heat and moisture are unfavorable to the existence of ozone, the amount developed by summer lightning is quickly destroyed. Not so in winter, when the conditions for the preservation of ozone are frequently ideal—low temperatures and absence of dust after snows.

The whole series of tests studied in connection with the daily government weather maps proved beyond a doubt that the maximum ozone content of pure country air was found only when "high" barometric areas were so near that the air from great heights rapidly flowed down to the observer. Owing to greater extremes of temperature the storm areas are more frequent and intense in winter; hence the quicker transfer of high air to the surface. It is, of course, understood that "high" pressure areas are merely heaped up masses of air moving across the continent as regions of fair weather. The top of this heap falls and flows out in all directions from the center. The nearer the observer is to this center the greater the amount of ozone he finds in the air. If so far away that he is actually in a "low" area the winds blowing to him from the "high" will have traveled over a long stretch of the earth's surface, and the ozone beginning the journey will have been destroyed by moisture, dust, organic matter and, in some seasons, by heat.

These observations confirm the hypothesis that nearly all the ozone found in the lower air was made miles above the earth by the action of ultra-violet light on cold, dry oxygen. Naturally the quicker great bodies of this ozonized air fall to the earth the less chance there is for destruction of the ozone. Strong "high" barometric areas furnish these conditions.

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preservative influence of low temperatures will alone account for the phenomena recorded. Such is not the case, for the coldest weather did not always produce the best ozone tests. On January 29th, 1912, Indiana (where the observations were made) was in a "low" pressure area and practically no ozone tests could be secured. The next day, January 30th, a powerful "high" area advanced from the Rockies and covered Indiana. The best tests of the year were obtained, although the temperature was only 21 deg. Fahr. *above* zero. On another day when the temperature was 30 deg. Fahr. *below* zero a very good test was secured, but still much inferior to that of January 30th.

Obviously the time to get out of doors is when the barometer is rising rapidly, even if the cold is intense. The treatment of tuberculosis patients in the Adirondacks hospitals, where they are pushed out of doors in the most severe winter weather, is justified. Such apparently cruel weather is caused by a rapid succession of "high" areas, and the accompanying ozone stimulates the nerves governing respiration and circulation.

The hot summer of 1911 was poor ozone weather. January and February of 1912 were remarkably fine (and it was an unusually healthy winter), the summer of 1912 much above the average summer weather, but this present winter has been rather poor in ozone—certainly much inferior to the previous winter. "What is so rare as a day in June?" might well have been asked of June, 1912, a month that, in the Middle West, brought more ozone than some winter months. June, 1911, deserved no poetic raptures, for it furnished very ordinary ozone weather.

A New Fish-curing Method

A METHOD has recently been introduced in Halifax, Nova Scotia, which promises to revolutionize the fish industry wherever carried on to any considerable extent, says Vice Consul General Eugene M. Lamb.

This process is based upon the theory that putrefaction of fish is first caused by bone taint, due to the fact that in the old methods of curing fish the specific or animal heat is partially left within the fish. The new method which has been introduced acts as a preventive to bone taint, completely removing the specific or animal heat from the fish to be cured.

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Antarctic Postage Stamps

AN interesting echo of Capt. Scott's antarctic expedition is the statement in the London *Times* that the British postal authorities are offering for sale all that are left of the special postage stamps issued for the benefit of the expedition, the proceeds to be used toward completing its work. Captain Scott was appointed by the government of New Zealand postmaster of Victoria Land, in the Antarctic, and Paymaster Francis Drake, R.N., assistant postmaster. There were, in all, three mails each way and one registered mail, carried by the "Terra Nova" from the base of the expedition in Victoria Land to New Zealand, or to other ships. All mails from the Antarctic bore the current penny and halfpenny stamps of New Zealand, surcharged. These now command at least 5 shillings and 25 shillings, respectively.

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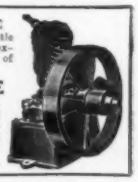

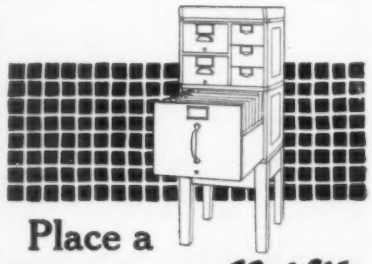

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Notes and Queries

Kindly keep your queries on separate sheets of paper when corresponding about such matters as patents, subscriptions, books, etc. This will greatly facilitate answering your questions, as in many cases they have to be referred to experts. The full name and address should be given on every sheet. No attention will be paid to unsigned queries. Full hints to correspondents are printed from time to time and will be mailed on request.

(12927) C. J. asks: 1. Does the speed that light travels vary in ether or a vacuum from its speed through the atmosphere? In calculating the distance of constellations and nebulæ in light years is this variation in speed (if any) taken into consideration? A. The velocity of light in a vacuum, or the ether, is greater than it is in air in the ratio of 1 to 1.0003. This need not be taken into the account in determining the light years of the stars, because the air is only a few hundred miles in thickness at the most, and light requires less than a six hundredth of a second in traversing the earth's atmosphere. This is a vanishing quantity as compared with the time required for light to come from the nearest star. 2. Is the constellation known locally in Cuba as the "May Cross," because of its being visible better in that month, the true Southern Cross? What latitude farthest north can the true Southern Cross be seen at all from? A. The Southern Cross, the true Southern Cross, is highest in the evening sky in the month of May, so that it is seen farthest north on the earth in that month. Its principal star, *a* Crucis, is about 62 deg. south declination, so that it can be seen below 30 deg. of north latitude.

(12928) E. T. W. asks: We have men who work at Bradley hammers, where the work is passed to them by a helper, so that they are compelled for hours at a time to look at metal near the white heat. We have provided heavy plate-glass shields to protect the men from flying sparks and hot scale. The writer has heard that mirrors have been constructed which were transparent from the back. The idea has been advanced that such a mirror could be used in this case and would reflect a large amount of the heat, at the same time enabling the operator to see the work. Have you ever published anything on the subject of making such a mirror? Do you know who could furnish such mirrors? A. Glass is silvered for mirrors and such a coating may be put on that it will be quite transparent, but will reflect much heat and light, thus to a degree protecting a workman who stands behind it. This process is described in our SUPPLEMENT 1671, which we will send for ten cents. Should you wish to get a large plate silvered, you can probably have it done by John A. Brashear, Allegheny, Pa. This firm makes mirrors for telescopes. Perhaps the Pittsburgh Plate Glass Company could do the work cheaper.

(12929) C. W. P. asks: I shall probably soon need a camera for work in which a low-priced lens would be sufficient; however, there is a possibility that I may want to make stereopticon slides from the negatives, and would like to know your opinion as to what kind of camera lens would be satisfactory for such work. A. For making lantern slides a negative 3¼ x 4 inches is most convenient, since the slide can be made by contact, and a copying camera for reduction is thus rendered unnecessary. A camera taking a picture of this size, 3¼ x 4 inches, is all that is required for making lantern slides, and the adjustment of the picture to the size of the opening of the mat, about 3 x 3 inches at the largest, can be made when the picture is taken. Now as to the lens, it is not good economy to use a cheap lens. The better the lens the better the work, the sharper the focus, the flatter the field, and the focus at the edges of the field. With a cheap lens the edges of the field cannot be in as good focus as the center. You would better have a cheap, home-made camera and a good lens than the best camera and a cheap lens.

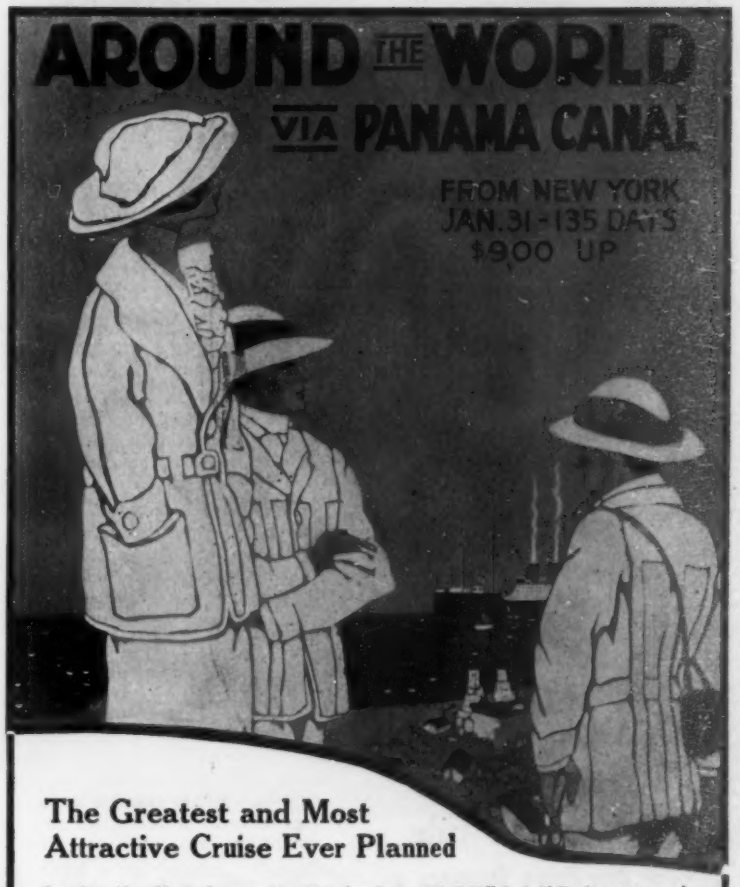
(12930) E. F. asks: I am in receipt of your letter of November 19th, and note that you say that "the air nearby may be somewhat above 32 deg." As a matter of fact, I have seen frost when the temperature of the air several feet above ground was as high as 36 and 38 deg. Several nights during the early fall, when the temperature did not go below 36 deg., there was still a heavy covering of frost, due to the rapid radiation of heat from the ground, and the consequent lowering of temperature of the dew below the freezing point. I wanted to know whether any experiments had been made to determine whether frost formed at a still higher temperature than that observed by me. I desire to thank you for your reply to my last letter, and if you have any further information on the subject, kindly advise me. A. As we wrote you before, the temperature at the point where frost forms must be 32 deg. Fahr. What the temperature may be a few feet or a few inches away no one can say. The air is a non-conductor of heat. If the air is still, it may be higher than 32 deg. very near the place where frost is forming. We have many times formed frost in a room where the thermometer was above 70 deg. Fahr. by evaporation of a volatile liquid. If the air is in motion the temperature in the neighborhood of the frost will not differ perceptibly from 32 deg. Fahr. We do not see how any exact statement of temperature as you desire can be made.

(12931) G. T. S. asks: A friend of mine has an agate which he found on the Oregon coast, and one surface of which he has had polished. There is an opening in the agate about an inch long, and this opening is partially filled with water. Will you kindly let me know through your Notes and Queries columns how the water got inside the agate? A. The mode in which an agate is probably formed will explain the occurrence of water included in some of these stones. It is probable that there existed a small pocket or crack in the rock. Water holding silica in solution worked its way into this cavity and deposited a layer of silica. This was repeated for a long time, until the agates in layers resulted. If the agate formed in a spherical or rounded cavity, the result might easily be that water would be inclosed in the completed stone. The water might be nearly invisible if the cavity was completely filled; but if a space was left unfilled, the water could be seen as the stone was shaken. This is the theory held by mineralogists to account for the frequent inclusion of water in such crystalline stones.

(12932) L. G. B. asks: Given one large jar of water, and another of mercury, both at the same temperature, and immerse in each the bulb of a thermometer cooled to 20 degrees below the temperature of the water and mercury, will the temperature of both thermometers rise 20 degrees in the same time? A. The thermometer will rise more rapidly in mercury than in water. Mercury is a metal, and metals are better conductors of heat than are the non-metals. Indeed, water is one of the poorest conductors of heat. It is usually heated by convection. 2. Will you please give an exact and absolute definition of temperature? I have an elaborate modern treatise on heat, the first chapter of which is devoted to temperature, without, however, defining it. A. Temperature is the thermal condition of a body which determines the transfer of heat between it and other bodies. It is therefore the relative intensity of the bodies in relation to sensible heat, or heat which can affect a thermometer. Absolute temperature is simply temperature as referred to the absolute zero of the scientist. 3. Is it settled beyond dispute that a gas does not fall in temperature in expanding unless it does work? If so, what is the proof? A. It seems to be settled that a perfect gas would not fall in temperature in expanding. But a perfect gas is hard to find. Most gases are imperfect and are cooled slightly in expanding. Hydrogen is a pluperfect gas and is not cooled sufficiently by expanding. Joule and Thomson's experiments are described in Poynting and Thomson's "Heat," page 296, "Internal Energy Taken Up by a Gas in Expanding." We will send the book for $4.25 postpaid. 4. If it does lose heat in expanding without doing work, what becomes of the heat? A. The heat is used up in doing the work of expanding the gas, if it is lost from the gas. 5. Does the statement that it takes nine times the quantity of heat to raise the temperature of a pound of water one degree that it takes to raise a pound of iron one degree, mean that all the heat applied in each case is completely absorbed? Or does it mean that the heat passes through and out of the water with only one ninth of the effect upon its temperature that it has on the iron? A. The specific heat of a substance is the quantity of heat actually required to raise a unit weight of that substance one degree as compared with the amount of heat required to raise unit weight of water one degree. The heat must all of it be absorbed by the substance. Iron will be heated about nine degrees by the quantity of heat which will heat the same weight of water one degree. Excepting hydrogen, water has the largest specific heat of any substance.

(12933) E. F. S. asks: I would like to ask through your paper in regard to generating acetylene and under what pressure it will liquefy, and if any danger in using plunger pump to compress same? A. Acetylene is best generated by dropping the calcium carbide into a large quantity of water, since the heat of the chemical action is then taken up by the water. It cannot be liquefied at a temperature above 98 deg. Fahr. At this temperature a pressure of 68 atmospheres, 1,020 pounds per square inch, is required to liquefy the gas. At the freezing point a pressure of 21.53 atmospheres, 323 pounds per square inch, will liquefy the gas. The explosions, which resulted in loss of life, from compressing the gas in cylinders, together with other troubles, stopped this mode of using it. At the present time it is dissolved in acetone, which will dissolve twenty-five times its own volume of acetylene at atmospheric pressure. It has proved safe to pump it into acetone. You will find the information you require in Leeds and Butterfield's "Acetylene," which we send for $2.75 postpaid.

(12934) W. H. D. asks: At what temperature does water commence to expand before freezing condition exists, and up to what temperature does it get when ice forms? What is the comparative pressure per square inch of this expansion? A. The temperature of the maximum density of water is 4 deg. C., and from that temperature the water expands till at 0 deg. C. it begins to change into ice. The corresponding degrees in Fahr. are 39.2 deg. for maximum density, and 32 deg. for the freezing point. The force of the expansion of water as it turns to ice is nearly 2,000 atmospheres. The volume of ice is about 0.09 greater than that of the water from which it is formed. Water is compressed 46 millionths for each atmosphere. To compress water 0.09 will therefore require 1,950 atmospheres. This is over 29,000 pounds per square inch.



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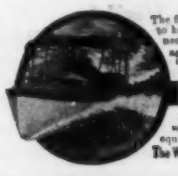

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CHIPPEWA MUSIC. II. By Frances Densmore. Smithsonian Institution, Bureau of American Ethnology, Bulletin 53. Washington: Government Printing Office, 1913. 8vo.; 341 pp.; illustrated.

Bulletin 53 is a supplementary volume to Bulletin 45, and continues Miss Densmore's studies of Chippewa, or Ojibwa, music, particularly in its relation to tribal life. There are songs of their games and their dances, songs "composed in dreams," and those of the famous drum-presentation ceremony are given, with description. In the present volume the melodic and rhythmic analysis of the music is continued. The Rev. C. H. Beaulieu, a member of the tribe, is responsible for the analysis of the words and for a part of the translation.

HAND-BOOK OF TEXTILE CORPORATIONS. 1913. New York: Frank P. Bennett & Co., Inc. 8vo.; 744 pp.

The hand-book is compiled for the benefit of three classes of readers—the bankers, the brokers, and the investing public—and is sold with the understanding that purchasers may make unlimited inquiries about the finances, equipment, production, etc., of the listed mills. The work is a co-operative compilation, in that it has received information and aid from bankers and from the manufacturers themselves. The result is an authentic reference volume giving the location, capital, officers, production, power, and markets of every textile mill in the country.

PRACTICAL USES OF THE WAVE METER IN WIRELESS TELEGRAPHY. By J. O. Mauborgne, First Lieutenant 24th U. S. Infantry. New York: McGraw-Hill Book Company, Inc., 1913. 8vo.; 74 pp.; with diagrams. Price, $1 net.

The basis of this work has been used as a reference text at the Army Signal School, Fort Leavenworth, Kansas, but in its amended form it is very well adapted for use in commercial and technical schools. The book describes the types of wave meter used by the U. S. Signal Corps, explains how the meter is used as a receiving set, in measurements with the helium tube, and with the telephone, or galvanometer, and detector, and deals with sending-station tuning. The final three chapters go with great detail into the measurements of damping, wave lengths, capacity, and inductance.

ADVERTISING AND SELLING. Principles of Appeal and Response. By Harry L. Hollingsworth, Instructor in Psychology in Columbia University; Lecturer in Business Psychology, School of Commerce, New York University. Published for the Advertising Men's League of New York City, Inc. New York: D. Appleton & Co., 1913. 8vo.; 314 pp.; illustrated. Price, $2 net; by mail, $2.16.

We have often wondered why there was such a comparative dearth of books on the finer principles of advertising and salesmanship. Here is one that attacks the problem at its root, along known psychological principles dealing with and governing the arrest of attention. Far from being academic, however, the work is intensely practical, and demonstrates its contentions by actual examples of present-day advertising. It goes further. It takes these examples and tabulates for us their results. It takes various advertisements of the same goods, with the number of replies each brought; it thoroughly considers the incentives—mechanical and interest-catching. Colors, types, relevant and irrelevant illustration are dwelt upon in their relation to attracting and holding the interest. No phase of the subject, no matter how remote or subtile, seems to have been overlooked. The suggestions of the work should in many instances lead to a large increase of efficiency in the advertising and selling department.

GRAPHICS AND STRUCTURAL DESIGN. By H. D. Hess, M.E., Professor of Machine Design, Sibley College, Cornell University. New York: John Wiley & Sons, Inc., 1913. 8vo.; 426 pp.; 429 figures. Price, $3 net.

This is a Cornell University text, in which the subject of structural design is broadly treated, the problems linking civil and mechanical engineering. The determination of stresses, it may be stated, is by no means confined to graphical means, as the title of the work might imply. The inclusion of a plate-girder railway bridge, though somewhat foreign to the spirit of the work, nevertheless serves the purpose of clarifying certain questions as no other illustration seems to do, besides pointing the use of the moment table. The volume may also find a field of usefulness as a reference book for designers.

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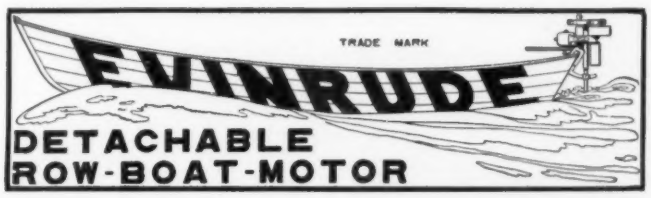

Weighs 50 lbs.—carries like a satchel

Adopted by 10 Governments

and Theodore Roosevelt has purchased one for his South American trip. Other prominent explorers and sportsmen use them in all parts of the world.

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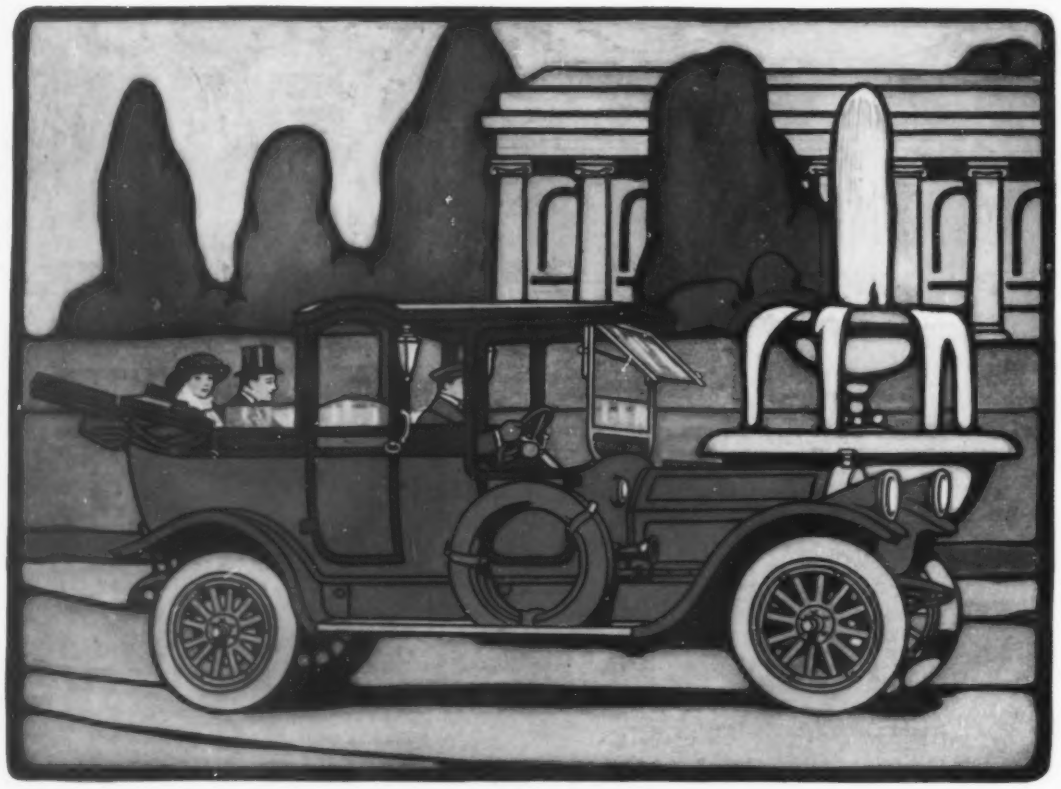

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The Pierce-Arrow Motor Car Company, Buffalo, N. Y.